American Machinist

October 26, 1932

Statistical Control In Sampling Inspection

H. F. DODGE
Bell Telephone Laboratories

A new approach to a difficult inspection problem promises real economies

JUDGING the quality of any product by inspecting every piece is one thing. Judging its quality by inspecting only a sample of the whole is quite another. Ask an inspector to inspect completely three kegs of bolts for visible defects. He needs no further instructions—he will proceed at once to examine each bolt separately and sort out the good from the bad. But ask him to inspect the bolts for breaking strength. First of all he can't very well test them all, for the test itself is destructive. He must make a sampling inspection. Secondly, if he is told that the three kegs come from a single supplier, he will select his sample bolts and interpret his results one way; if he is told that the three kegs come from three different suppliers, he will probably proceed in quite a different fashion, tending to treat the bolts in each keg separately. Thus when sampling is necessary, special problems arise.

The breaking strength values for the individual bolts will vary considerably among themselves; the distribution of results for a group of test bolts will almost invariably differ from that which would be obtained were the inspector to test all the bolts to destruction. This inherent variability of sampling casts a cloud of uncertainty over his estimate of the quality of the whole. But there are ways and means of reducing the darkness of this cloud to a minimum, vested in a program of "statistical control" that the producer can make use of, not only to the advantage of the consumer but to his own advantage as well. It is the purpose of this discussion to indicate the role played by statistical control, in the particular sense here used, wherever it is necessary or desirable to judge quality from the results of sampling inspection.

First let us consider the nature of the variations that may be expected in the results obtained from sampling. We will take the breaking strength of $\frac{5}{8}$-in. machine bolts as an example.

In preparing to manufacture this type of bolt, the producer sets up a production plan which involves materials, men and machines. This plan encompasses a complex system of causes of variation, each element of which contributes to variations in the breaking strength of the individual bolts in the finished product. Prominent among the causes which affect the uniformity of breaking strength of the individual bolts are variations in the carbon content of the steel, in the impurities such as sulphur and phosphorus, in the homogeneity of structure from point to point within the material, in the conditions of heat treatment, in the diameter of the rod stock, and in the conditions relating to the forming and machining processes.

Each of these causes considered independently, contributes a share to the variations in the quality of the finished product, and no matter how excellent the production technique may be, there will be a scattering of values of breaking strength around some central value. If each of the causes of variation continues to have the same probability of contributing a given effect, then the breaking strength of the product may be said to be controlled in the technical sense. This point is developed fully in "Economic Control of Manufactured Product," by W. A. Shewhart, published by D. Van Nostrand Co. Under these conditions, the cumulative effect of all of the causes can be represented by an overall distribution curve, such as that shown in Fig. 1. This curve can be regarded as an objective representation of the entire production process, in respect to breaking strength. For any range of values, say from 12,500 to 13,000 lb., there will be a corresponding value of probability ($p' = 0.15$), numerically equal to the ratio of the area under the curve within this range to the total area under the curve, which is the probability of producing a bolt having a tensile strength in this range. Any change introduced by the manufacturer that affects one of the major causes of variability, such as carbon content or uniformity in diameter of rod stock, will be reflected by a shift in the average value of this distribution, by a widening or narrowing of the range of variation, or by both, and as a consequence there will be an attendant change in the value of probability p' for the range, 12,500 to 13,000.

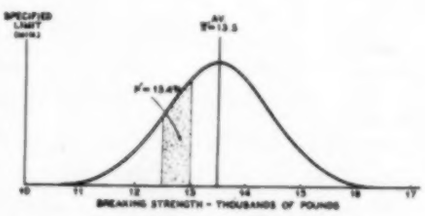


Fig. 1—Distribution of breaking strength—$\frac{5}{8}$-in. machine bolts

This appears, of course, to give to our concept of control a very rigorous and theoretical aspect for it may well be argued that it will not be possible to

Paper presented at the round table discussion on "Aquisition of Good Data" under the auspices of the Technical Committee on Presentation and Interpretation of Data, A.S.M.E. Committee E-1 on Methods of Testing, annual meeting, June 20, 1932, Atlantic City.

uphold such a high degree of constancy in the entire stream of product, turned out from any industrial production process. We will for the moment at least use this concept as a simple ideal, and subsequently indicate in what way it may be modified to meet practical needs without disrupting any of the tenets of the underlying philosophy of statistical control.

From a sampling standpoint, the distribution curve just described may be considered as representing a "universe," and successive lots or samples from those lots may both be looked upon as samples from the universe. So long as this universe remains the same, we can predict on a probability basis just how the observed distributions for lots of 10,000 bolts, for lots of 1,000 bolts, or for samples of 10 bolts, may be expected to differ from this true distribution curve.

To do this, we ordinarily find it convenient to express any set of observed values of breaking strength for a sample of n bolts

$$X_1,\ X_2,\ X_3, \ldots\ldots X_n$$

in terms of simple statistics of these values, such as the arithmetic mean

$$\overline{X} = \frac{\text{Sum of Observed Values}}{\text{Number of observations}} = \frac{\Sigma X}{n};$$

the standard deviation, (root mean square deviation around X)

$$\sigma = \sqrt{\frac{\text{Sum of (Observed Value} - \text{Arith. Mean)}^2 \text{ for all obs.}}{\text{Number of Observations}}}$$

$$= \sqrt{\frac{\Sigma (X - \overline{X})^2}{n}}$$

and the fraction, p, of the total observations that fall inside (or outside) of certain stated limiting values of breaking strength.

For successive samples, the observed values of $\overline{X}$, σ and p will fluctuate around the objective values $\overline{X'}$, σ' and p', of the distribution curve representing the production cause system. Fig. 2 indicates for example the range within which we may expect approximately 99 per cent of the observed values of these statistics to fall, under these controlled conditions. The dotted boundary lines of this range are determined from the following equations

$$\text{limits for } \overline{X} = \overline{X'} \pm 3\frac{\sigma'}{\sqrt{n}}$$

$$\text{limits* for } \sigma = c_2\sigma' \pm 3\frac{\alpha'}{\sqrt{2n}}$$

$$\text{limits for } p = p' \pm 3\sqrt{\frac{p'(1-p')}{n}}$$

It will be noted that the range of variation will be relatively small for large

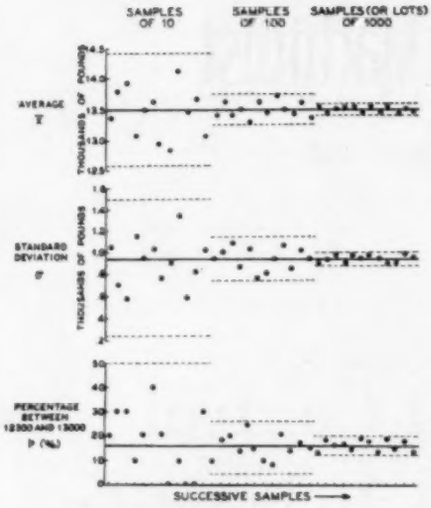


Fig. 2—Showing variation in observed values *of X, σ and p*

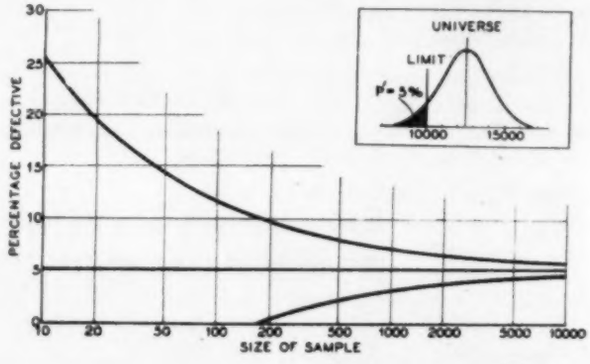


Fig. 3—Expected range of variation in observed percentage defective— ± 30 limits

samples, the range decreasing inversely as the square root of the sample size.

*Where c_2 is a constant dependent on sample size,

n	c_2
4	.798
5	.841
10	.923
20	.962

Now suppose that we specify that each bolt shall have a breaking strength of not less than 10,000 lb. Suppose further that as a result of some manufacturing irregularity, the system of causes in the production process is such as to give an objective distribution as indicated in Fig. 3, in which 5 per cent of the bolts may be expected to have a breaking strength of less than 10,000 lb. Then the range of scattering of observed values of percentage defective (percentage of bolts having sub-standard breaking strength) around the 5 per cent level would be dependent on the sample size in the manner shown. For example, if a sample of 180 bolts were measured, the results might show anywhere from 0 to 10 per cent of them with breaking strength below 10,000 lb., even though only 5 per cent of the entire universe of bolts were below this value.

The results indicated in Figs. 2 and 3 represent what may be expected under theoretically ideal conditions — when sampling from a universe whose distribution is known exactly. The use of probability theory under such conditions involves reasoning from the general to the particular, that is, from a known universe to unknown samples.

In the practical case, unfortunately, we never know just what the universe contains. Instead we must use inductive reasoning—the process of inferring the general, from observation of the particular. That is, we estimate the quality of a lot or universe from the results of inspecting a sample drawn therefrom. In Fig. 2, for example, the observed result might well have been any one of the points shown. From that result, we would attempt to reach certain decisions such as—Is the lot satisfactory for use? or, Is the system of production causes functioning properly?

Sampling inspection is usually conducted for one of two immediate purposes (Fig. 4):

(a) *Control* of quality and of process—in which the sample is regarded as a sample of the *universe*, and unfavorable results are taken to indicate the need for doing something to the *process*. A producer's inspection of his own product is made fundamentally for this purpose. This type of inspection provides machinery which will assist in detecting undesirable trends or irregularities in the quality of materials or workmanship. Such indications can be used as a basis for conducting investigations to find the causes of trouble, whereupon the producer can institute remedial action.

(b) *Protection* of the consumer in respect to specific lots—in which the sample is regarded as a sample of the *lot*, and unfavorable results are taken to indicate the need for doing something to the *lot*. The consumer's inspection of material submitted to him for acceptance is made fundamentally for this purpose. This type of inspection uses criteria that will give the consumer a reasonable degree of assurance that the lots he accepts are satisfactory for use. Unfavorable indications provide a basis for conducting further inspection or for rejection.

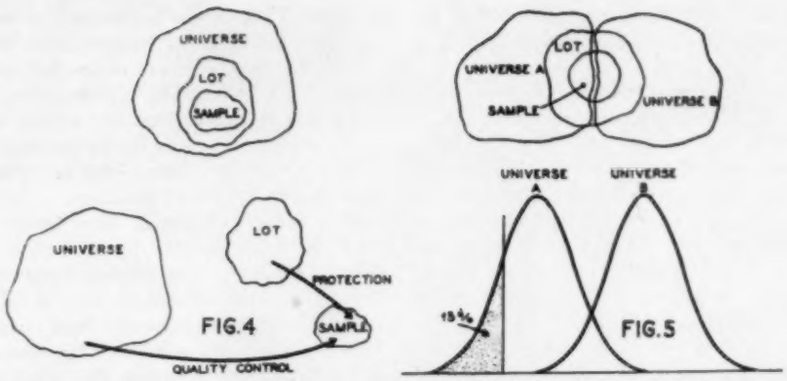


Fig. 4—Difference in attitude in inspection for (1) control and (2) protection. Fig. 5—The results of sampling under these conditions are difficult to interpret

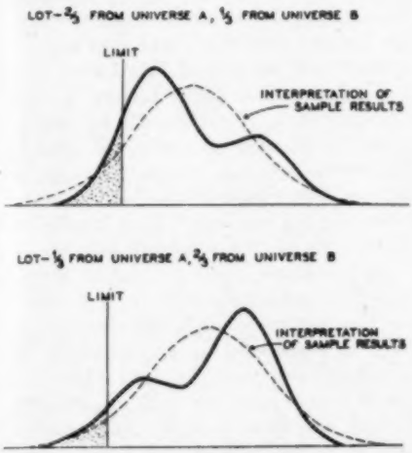

LOT-⅔ FROM UNIVERSE A, ⅓ FROM UNIVERSE B
LIMIT
INTERPRETATION OF SAMPLE RESULTS
LOT-⅓ FROM UNIVERSE A, ⅔ FROM UNIVERSE B
LIMIT
INTERPRETATION OF SAMPLE RESULTS

Fig. 6—Assumption of homogeneity gives misleading results

From an economic standpoint, sampling for control is probably the more important of these two purposes. Sampling for the second purpose, protection, is necessary, however, wherever the consumer lacks assurance of continuing uniformity and satisfactoriness of the quality of product delivered to him for acceptance.

Attention will be directed for the moment to that phase of inspection which relates to protection—where inspection procedures are set up to limit the risk to the consumer of accepting lots of unsatisfactory product.

Many specifications prescribe quality standards, testing methods, inspection procedures, sample sizes and acceptance criteria. The purpose of the inspection plans is in general to prescribe conditions under which specific lots or quantities may be considered satisfactory for acceptance by the purchaser.

Quality requirements are usually specified for all important service characteristics, and often consist of limits to be met by each piece or portion of the product. For example, to be considered conforming, (In accordance with A.S.T.M. Standard Specifications A51-21, B36-27, and A122-30) the shank diameter of each quenched alloy steel track bolt must not exceed the specified diameter by more than $\frac{1}{64}$ in., each 6-in. wide strip of sheet high brass of No. 10 B & S gage must not at any spot differ from the specified thickness by more than ± 0.0030 in., each test specimen of 0.207-in. diameter galvanized steel wire strand must withstand without failure at least 4 one-minute immersions when subjected to the Preece Test.

If the product consists of discrete pieces, such as bolts, or bricks, each of which can be measured for a given characteristic without destoying it, then errors of sampling can be avoided by conducting a 100 per cent inspection as a sieve, measuring each individual piece and sorting out the good from the bad.

For many features, however, 100 per cent inspection may be either impracticable or impossible. This is the situation for any quality characteristic,

(1) if the product is continuous in respect to the characteristic in question and is not naturally made up of discrete pieces which can be separately tested (Examples, physical and electrical properties of material, such as hardness of sheet brass, resistance of copper line wire), or

(2) if the test is destructive in respect to the characteristic in question—inspection of every piece would mean the complete destruction of the product (Examples, breaking strength of bolts and bend test of brass pipe).

Under these conditions, reliance must be placed on sampling a small portion of the lot and we are forced into the position of judging the quality of the whole from the results of inspecting only a part. The quality of the sample may be expected to differ from that of the lot—the smaller the sample, the wider may the difference be.

Thus, if there is no alternative to sampling, a specified limit for an individual piece is unenforcible. When sampling is employed, there can be no absolute assurance that the limits have been met; instead it is possible to have only a degree of assurance as measured in terms of probability.

Under what conditions can a sample give a definite degree of assurance that a lot which fails to meet the specified requirements will not be accepted?

Suppose for example, that the lot under consideration were composed in part of material from a universe for which the percentage defective is 15 per cent, and in part of material from a universe whose distribution lies entirely above the specified minimum limit (i.e., 0 per cent defective). Let us say further that the proportions from the two universes indicated in Fig. 5 are entirely unknown, that in making up the lot no consideration whatsoever was given to the fact that there were two distinctly different sets of production conditions. The lot as presented for acceptance is thus far from homogeneous. Under these circumstances, the inspector will be unconscious of the dual nature of the lot, and lacking any evidence to the contrary, he will naturally incline to assume that the lot is homogeneous in quality. Depending on what proportions of the lot came from the two universes, the distribution of its quality might look somewhat as shown by the heavy curves in Fig. 6. But the tacit assumption of homogeneity and the computation of such statistics as X, σ and p for the sample data will ordinarily lead to the conclusion that the quality of the whole is distributed in the manner indicated by the dotted curves, a conclusion whose error, of course, depends on the magnitude of the difference in quality between the two component parts of the product sampled.

Bad for Consumer and Producer

Inspection conducted under these conditions imposes hardships both on the consumer and on the producer. The consumer runs the risk of accepting the unsatisfactory material from universe A (Fig. 5) and the producer runs the risk of having the entire material rejected, although that from universe B is entirely satisfactory. When products of different quality are thrown together in some such unknown way to make up lots, it is difficult if not impossible to measure the risks of sampling.

But what *can* be done when the quality of different portions of the product are not controlled at the same level, when the quality of one production unit differs significantly from that of another, or when seasonal or long-term influences are beyond the control of the producer? While we may state informatively in our specifications that it is desirable to have the quality of all

portions of his product controlled at the same level, it may not be feasible economically to specify and demand it. There appears to be only one solution to this problem. It relates to certain requirements that should be imposed upon what are designated as lots for sampling inspection purposes.

First of all, if the entire run of product is not produced under the same essential conditions, it should be broken down for inspection purposes into rational sub-portions, for each of which the conditions of production are essentially constant. *Then*, any quantity of material submitted as a lot for inspection should be either (a) homogeneous in quality, i.e., made up of pieces or material all of which represent but one of these rational sub-portions, or (b) sub-divided into a number of homogeneous sub-portions, each bearing suitable means of identification. Basically, a requirement to this effect, when placed in standard procedures for sampling inspection, makes a demand for conditions which will yield good data. So far as inspection is concerned, if (b) is taken as the alternative each of the sub-divisions of the lot may then be represented independently by a sub-sample and judged on its own merits.

Just what constitutes a rational sub-portion of product cannot be determined by any *formal* method. This problem brings into play human judgment and a knowledge of production conditions. But such judgment aided by the use of statistical criteria that have been developed for testing the consistency of quality variations provides a mechanism of practical usefulness.

It is often convenient to consider any continuous production process as one of two types (Fig. 7):

Type 1—Where the output is composed of one (1A) or more (1B) streams (sub-portions) of product flowing continuously from one or more reservoirs, each symbolizing a cause system that remains essentially constant with time;

Type 2—Where the output is composed of successive limited quantities (sub-portions) of product, for each of which the cause system remains constant during the time required to produce that quantity, but where between the time of producing one such quantity and the successive quantity an adjustment or change is made in the cause system so that the quality of one batch may be expected to differ from that of other batches.

An example of Type 1B is found in the variations of physical properties of rolled sheets of non-ferrous metals. Even under what may now be considered the best method of production, the thickness of a sheet of brass may be expected to follow a profile somewhat as indicated in Fig. 8—thinner at the edges than at the center. In addition there will, of course, be variations in thickness along the sheet. After slitting to make up rolls of narrower strips, we may expect the average thickness of the strips made from the edges of the sheet to be less than that for strips made from the center, if there is no rerolling after slitting. Likewise, we may expect physical properties, such as hardness and tensile strength, to be different for the outer rolls than for the inner rolls because of greater work hardening. The product as submitted for inspection cannot be considered as homogeneous but rather one that is made of several sub-portions, each possibly homogeneous in itself, but differing from the others because of causal factors in the process.

This situation is paralleled for many materials and finished products. Insulation resistance of phenol fibre tends to vary from the center to the edge of 38x42 in. sheets; the average depth of penetration of creosoted yellow pine poles may vary significantly from charge to charge because of factors introduced by the treating process; the breaking strength and dielectric strength of varnished cloth tape may vary systematically from roll to roll, as a result of the method of cutting rolls of tape from the sheet of varnished cloth, whose properties tend to vary from center to edge.

What will be termed "statistical control" deals with these factors in the following way. First it calls for identifying the causes of significant quality differences between various portions of the product, making use of statistical criteria in the analysis. Then it calls for taking one of the following two steps: either eliminate these causes, or if this is not economically feasible, sub-divide the product accordingly, into parts that may be considered as homogeneous for sampling inspection purposes. The producer alone may be in a position to decide in what manner his product should be broken down into parts. But the step is an important one from the consumer's standpoint since the reliability of his sampling data depends on the validity of his assumption that the quality of the product represented by the entire sample or by each of the sub-samples is homogeneous. His interpretations of sampling results are probability judgments, and as such, they depend on this assumption.

(To be concluded)

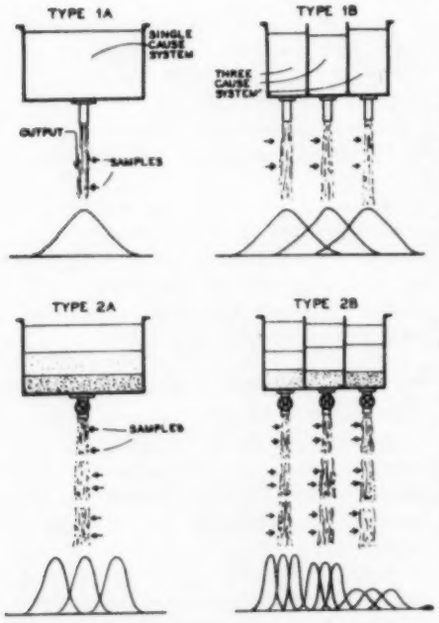


Fig. 7 — Two general types of production cause systems

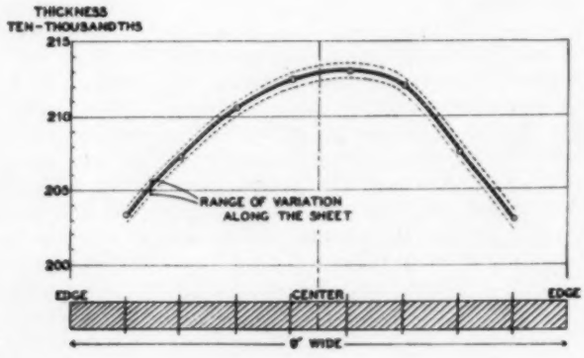


Fig. 8—Thickness variation across a sheet of brass — "A" brass, 4 numbers hard

Reaming Holes Without Bellmouth—*Discussion*

C. A. COPPACK
Leicester, England

A reamer for producing parallel holes was illustrated by Ernest Foldvary in an article under the title given above (*AM*—Vol. 76, page 836). It should be pointed out, however, that such a reamer has no tendency to make a straight hole; indeed the very fact that the turret holes are offset (and that is why this particular reamer was used) will definitely cause the reamer to wander from the straight path. There is no known method of producing *guaranteed straight* holes parallel from end to end in a turret lathe.

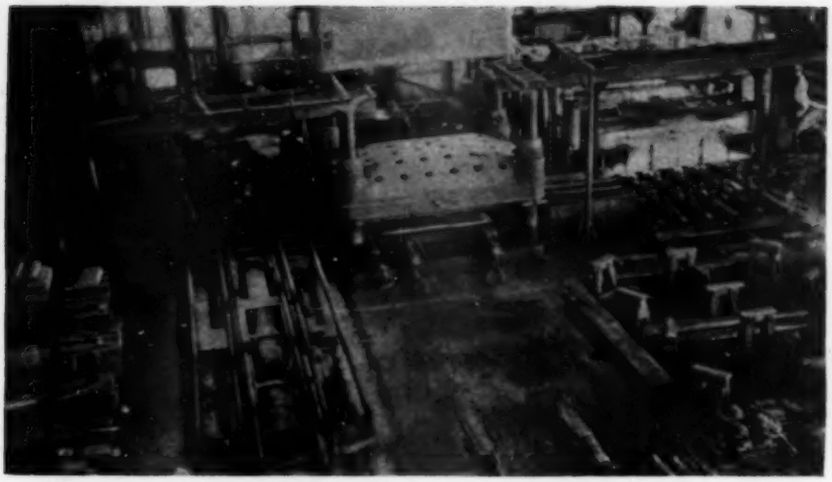


Fig. 1—General layout of the hydraulic press and furnace. The wooden horses at right support the top and bottom die holders when the interchangeable dies, parts of which are shown at left, are changed

Corrugating Steel Ends for Freight Cars

W. J. TANGERMAN
Shop Superintendent,
Union Metal Products Company

Steel plates, 6 x 8 ft. and ¼-in. thick, are fabricated at a rate of 85 an hour by a 5-man crew. The men handle 20 to 25 tons of metal per hour, yet without physical exertion

FABRICATING half a million pounds of steel, and with only five men in the crew including the foreman, sounds like a man-killing job. It was, but complete mechanization of the process now permits such production day after day in the plant of Union Metal Products Company, Hammond, Ind. The job is the corrugating of steel ends for freight cars, and the plates, which average 600 lb. apiece, vary from 7/16 to 1/4 in. in thickness, from 60 to 84 in. wide, and from 118 to 130 in. long. The record run is 926 plates in 11 hours, an average of about 85 an hour. Consistent production runs above 80 plates per hour have proved that this is nothing out of the ordinary, even though production by former hand handling methods did well to average 25 to 30 plates an hour, five hours a day.

Equipment, as diagrammed in Fig. 2, consists of a 12-burner oil furnace, a 2,000-ton Bethlehem hydraulic press, the accompanying furnace loading, furnace passage, push-on, pull-off, cooling and stacking rigs, and two blowers, one for the furnace, the other for cooling press dies. The crew is composed of foreman, furnace loader, furnace man, press operator and unloader. It is probably best to consider each element of the set-up in turn, and this will be done after a short summary of the operation.

Plates to be corrugated are brought in piles to a truck at one end of the furnace and off to one side. They are picked up singly by a Shepard hoist carrying twin magnets, and carried to the furnace door, where a gage positions them over the furnace passage rig. The rig carries them through the furnace in six steps. They remain in the furnace an average of 2½ min., three to four plates being heated at one time.

The heated plates are brought by the furnace passage rig to an incline leading onto the press and carrying a number of small rollers. The push-on rig, simply a carriage on an overhead trolley carrying a dependent pair of forked fingers, pushes the plate onto the press bed, where it is positioned by four side gaging cylinders and by an end bar-gage against which the push-on rig pushes the plate. As the gaging cylinders retract, the press platen rises and corrugates the sheet. As the platen falls away from the top die, the gaging cylinders are used again to lift the sheet slightly from the lower die. This permits a pneumatic bull-dog clamp on the pull-off rig to catch the end of the sheet and to pull it off the press bed. The sheet, as it crosses the cooling bed, is pulled loose from the bull-dog clamp by a pair of dogs which position it over the end of the cooling bed. It then passes, in five steps, over the cooling bed. It is dropped, black hot, over the end of the cooling rig onto the stack, removed periodically by overhead crane. Stacks are set in the open air to cool slowly.

In order that none of these operations

may occur out of synchronism, the controls are grouped so that each operator is dependent upon the preceding man. The furnace loader presses a button when the plate to pass into the furnace is in position. This lights a bulb before the furnace operator, notifying him that the furnace is ready. When the press lower platen has come to rest on the downstroke and the corrugated sheet is being removed, the furnace operator throws his control lever. This opens the furnace doors and at the same time carries a cold sheet in and a heated sheet into position before the push-on rig. He then throws the rig control lever. As the press operator sees the plate crossing the die, he extends the bar-gage pneumatically, followed by the gaging members as the sheet comes to rest. The gaging cylinder control lever projects in the way of the first press-operating lever in such a way that the operator cannot engage the operating lever until the gaging pistons have been retracted. Meanwhile, the pull-off rig operator has started the pressed sheet on its passage down the cooling bed. The off-coming sheet is positioned on the cooling bed by the tip-over dogs, and the pull-off rig operating switch carries a trip lever which insures that the pull-off clamp will be clear of the cooling bed before any other operation fouls it. The pneumatic cooling bed operating cylinder is similarly arranged. In other words, the operator simply throws two levers in sequence, and the cycle of operations is completed without any further attention from him.

Plates are piled in stacks of twenty or twenty-five under the overhead craneway in back of the shop. Double-opening doors in line with the plate truck at the side of the furnace permit the craneman to bring plates in, a stack at a time, and position them on the loading truck. This 4-wheeled truck has regular car wheels and runs on a section of track, so that it also may be moved slightly to insure centering under its load, as well as permitting it to be moved in front of the doors and out under the monorail upon which the Shepard hoist operates. When loaded, the truck is pushed back under the monorail, where the hoist picks the plates singly under control of the loader in a glass-inclosed booth at the end of the furnace.

The furnace itself, built by Surface Combustion Co., is 12 ft. 6 in. wide by 25 ft. long, and is 39 in. high at the center of the inside arch. It is oil-fired, using Hauck venturi-type burners and a Spencer blower which supplies a maximum of 6,000 cu.ft. per min. of air at a pressure of 16 oz. Controls on the blower fan, on the oil supply line, and on both lines at each burner permit accurate control of the heating, which must bring the plates to a temperature suitable for corrugating yet not so hot as to cause scaling. On ordinary steel, this temperature is a bright cherry, and is measured by means of a thermocouple and pyrometer.

The furnace operating rig is a long wheeled truck running on rails beneath the furnace. Its superstructure, operated by pneumatic means, is a series of water-cooled pipes running in troughs in the furnace and carrying welded-on punchings upon their upper surfaces for bearing purposes. When these pipes are lifted above the furnace floor, they lift the plates, then the truck moves forward, the pipes lower, and the truck returns. Both the truck and the pipe-lifting cams are operated by air cylinders controlled by the furnace man, as are the furnace doors, and all are connected together so that one lever controls the entire operation synchronously.

The furnace floor is of course of fire brick, and 8x8x13-in. firebrick were formerly positioned upon it for the plates to rest upon to permit circulation beneath them. These brick, costing 85 cents to $1.25 apiece, spalled so much that they had to be replaced at least once a month—an expensive item in a big furnace. They have now been superseded by the device shown in Fig. 2, consisting of 8x8-in. cubes set into a

Fig. 3—The furnace and push-on rig control position, showing the two interlocked control levers

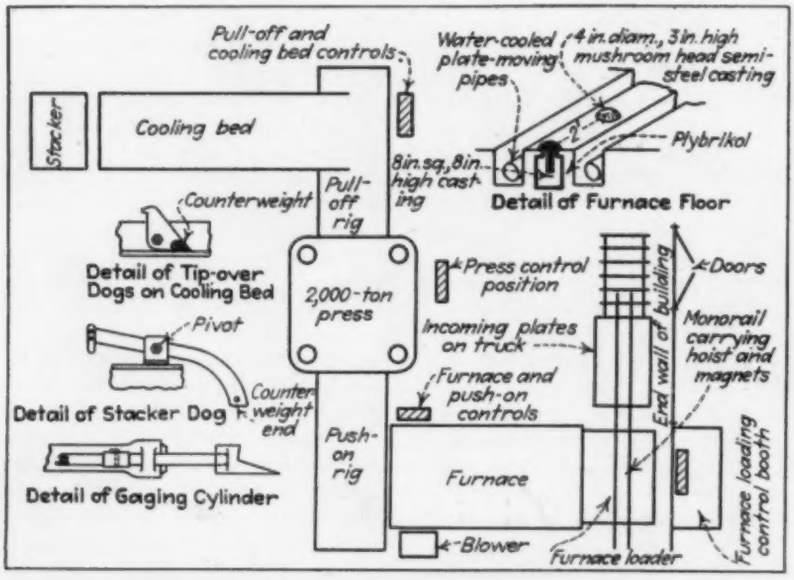


Fig. 2—General diagram of the press set-up, showing details of furnace and cooling bed construction

Plybrikol base 2 ft. apart in rows between the pipe troughs. Each of these castings has a bottle neck arrangement at its upper end which extends to the surface of the furnace floor. Into these openings semi-steel cast mushrooms 4 in. in diameter and 3 in. high are dropped. They provide a perfectly smooth, uniform, unspalling, upper surface to support the plates, and though their drop-in heads can be replaced without trouble, they have not been replaced since they were adopted two years ago. Alloy steels have been suggested for this high-temperature service, but simple castings have thus far proved entirely satisfactory.

Gas burners were formerly used in the furnace, but it has been found more economical to use oil. Present specifications are 18 gravity oil in summer and 14 gravity oil, steam-heated, in winter. Gas heating, including the 1-hr. preliminary heat, averaged about 1,300 cu.ft. of 1,000-B.t.u. gas per sheet; oil heating shows about 10.6 gal. of 14-gravity oil for ¼-in. plate.

The push-on rig, motor driven, runs on I-beam over the furnace door. The original design called for drive through the wheels simply by contact with the I-beams, but this was found impractical, so racks and gearing have been substituted. From the 4-wheeled carriage rigid arms depend. At the lower end of the arms are horizontal arms carrying forks which engage the back end of the plate. These arms are joined together and are adjustable for height. The plate itself is pushed over a series of cast rollers supported on I-beams leading up to the press bed.

The 2,000-ton Bethlehem press has an 8x12-ft. bed. Pressing is done by five cylinders to attain the full 2,000 tons, the hydraulic fluid being supplied by a line under 1,500 lb. per sq.in. pressure. The two small jack pistons carry the platen, with the male die and the plate, up into engagement with the upper, or female, die. The first two pressing cylinders form the corrugations, but the full pressure with the major cylinder must be used before all wrinkles and bends are ironed out properly. Unless this is done, the entire edge of the sheet will be left wavy and distorted.

Water-cooling of the dies was specified, but it was found unsatisfactory for several reasons, one being that sectional dies are used and that considerable difficulty attended the attaining of watertight joints. The present set-up embodies a 2,900-cu.ft. per min. blower and a fan-shaped spreader at the end of the delivery line which spreads the blast over the male die surface. Since the female die is in contact with the plate for only a short time, no especial cooling provision is necessary. The air blast on the male die also blows off any scale which might accumulate.

Sectional dies are used in order to cut expense. A pile of die sections may be seen at left in Fig. 1. These may be assembled in a variety of ways in a standard holder in order to attain the dozens of different plate lengths and numbers of corrugations. Die sections are usually semi-steel, although some corner parts and other wearing surfaces have been made of nickel-bearing steel or cornered with Stellite in order to increase life.

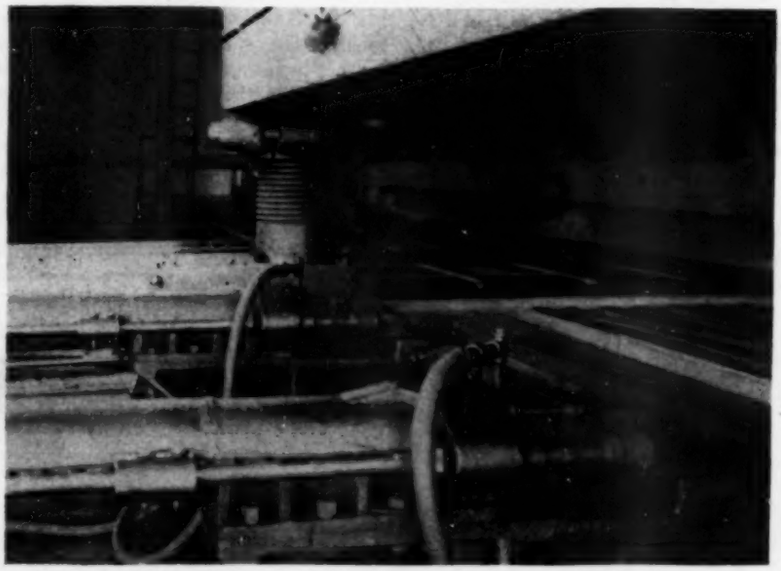


Fig. 4—Special heads and stroke-limiting means characterize the gaging cylinders. Bar gage in background at left, male die at right

Design of the pull-off rig is similar to that of the push-on unit, except that an air-cylinder operated clamp is substituted for the pushing elements and the pulled-off plates ride on rails instead of rollers. The cooling bed is simply a series of parallel rails, the inner running on rollers inside the outer. The inner rails are fastened together and are operated by an air cylinder. At regular distances along the moving rails, which are slightly below the surface of the stationary ones, are small tip-over dogs which catch the rear edge of the plate on the forward stroke but tip under it and allow it to remain stationary on the return. By this action the plate progresses along the bed, and is permitted to cool slowly in air.

At the end of the cooling bed is a space for stacking the plates. When the inner rails reach the end of their travel, they project beyond the outer ones the width of a plate. At the end of the cooling rig is also a pair of tip-over dogs which permit the plate to pass over them, but hold it as the rails retract. Thus the plate simply falls off the end of the rig onto the pile. The corrugations of the sheets cause them to pile vertically, so that the crane can pick them up without difficulty.

One element of the design worthy of more than passing interest is the gaging cylinder. These cylinders carry heads with two bars extending backward, one on either side of the cylinder. These bars pass through openings in the cylinder head, and carry collars which are adjustable to limit the stroke of the piston. The piston head is ususual in that it is used both for gaging and for lifting the plate after it is pressed. They have a jaw shape, with the lower half of the jaw acting as a lifting bar and the V of the jaw doing the gaging under adjustment of the collars on the side bars.

Setscrews That Held
Discussion

JOHN E. HYLER

The article by John Aures under the title given above (*AM*—Vol. 76, page 963) brings back memories. Although the scheme of using solder is very interesting, one can generally bring up setscrews tightly enough to hold by the judicious use of the hammer in connection with the wrench. The setscrew should be pulled up moderately tight with the wrench and then struck a few smart endwise blows with a light hammer. Whatever is gained by the hammer blows should be followed up by turning with the wrench. This process should be repeated once or twice.

Automatic Heat-Treating Equipment

D. L. BROWN

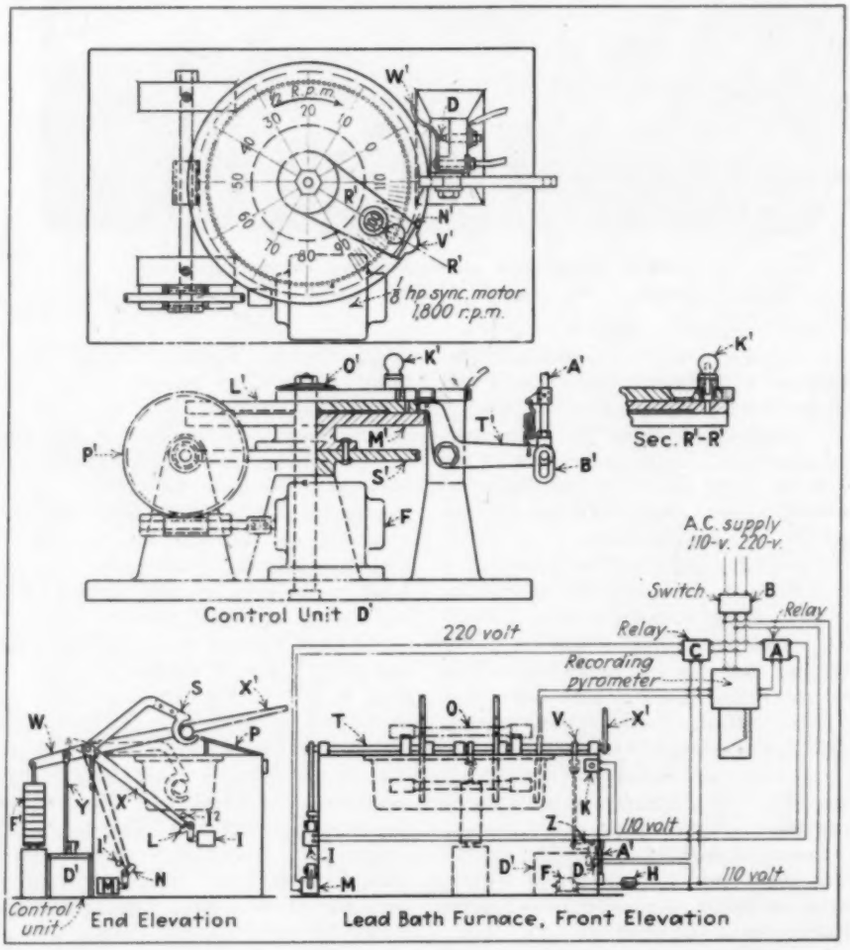
Complete automaticity in heat-treating, under adequate control, avoids arguments and improves quality

THE equipment illustrated controls automatically the time and temperature for heat-treating shafts, the heating medium being a bath of molten lead at a temperature of from 1,500 to 1,800 deg. F. The temperature is recorded on a recording pyrometer through a pyrometer inserted in the lead bath and the duration of time the work is being heated is automatically controlled by a synchronous motor. The pyrometer is connected to the recording pyrometer, which controls the relay *A* and closes the circuit at the temperature for which the pyrometer has been adjusted. The main switch *B* closes the 110 and 220-volt circuits, and the 110-volt supply is led to the pyrometer and also to a second relay *C* through the contact points *D*, which control this relay.

The 110-volt line continues directly to the ⅛-hp. synchronous motor *F*, which can be started or stopped through the switch *H*. The output of relay *A* is connected to the solenoid *I* through the contact switch *K*. This solenoid controls the release latch *L* and therefore it can not be unlatched unless the pyrometer indicates the required temperature. The relay *C* is connected to the 220-volt power supply and its output goes directly to the larger solenoid *M*. This solenoid controls the latch *N*, which is operated through the relay *C* by the contact points *D*. The shaft *O* to be heat-treated is approximately 3 ft. long and is required to be in the bath from 60 to 100 sec., according to its diameter. Tongs are used to slide the shaft up the guides *P* and into the swinging arms attached to the shaft *T*. These arms are provided with interchangeable hooks that can be replaced when badly burned. Levers *V*, *W* and *X* are also attached to shaft *T*. Lever *V*, connected by link *Y*, the rocker arm *Z* and the spring links A^1 and B^1 to the latch T^1, starts and stops the control unit D^1, as will be described later.

Counterbalance weights F^1 are connected to the lever *W* to hold the system normally in the unloading position indicated by full lines. A rubber block under the counterweights stops their downward travel without shock or undue strain to any of the mechanism. Stops at I^1 and I^2 locate the correct up and down positions of the shaft to be heat-treated. The control unit D^1 automatically times the heat-treating operation and can be set for any predetermined number of seconds from 1 to 100 by shifting the plunger K^1 into the correct hole in the control plate L^1, which is mounted between the driving plate M^1 and the cam lever N^1. The control plate is driven by friction and the tension can be adjusted by tightening or loosening the spring washer O^1. The synchronous motor, running at 1,800 r.p.m., drives the plate M^1 through the worm reduction gears P^1 and S^1 having a combined ratio of 3,600 to 1. Thus the driving plate revolves at one-half of one revolution per minute.

The latch T^1 engages a slot in the control plate and prevents it and the cam lever from revolving, except when depressed by the link A^1, which is so adjusted that the control plate is started revolving the moment the work is plunged into the lead bath. The cam lever, carrying the fiber contact block V^1 then rotates until the contact block touches the spring W^1 and closes the contact points *D*, controlling the relay *C*, operating the solenoid *M* and releasing the latch *N*. The counterweights then raise the work out of the lead bath. This action raises the link A^1 and extends the spring until the control plate again reaches the starting position shown, at which time the latch T^1 drops



into the slot in the plate and stops its rotation until the work has been plunged into the bath. The motor continues to drive the plate M^1 so long as the switch H is closed.

After the lead bath has been heated to the proper temperature, the operator slides the work into the swinging arms S, presses the contact switch K and plunges the work into the bath by moving the lever X^1 down until it locks. Plunging the work in the bath may reduce the temperature of the bath 50 deg., more or less, but the arms will remain locked in the loading position until the bath has been raised to the correct temperature.

It must be understood that this device is not intended to do away with manual labor entirely, but was designed primarily to prevent errors in timing the heat-treatment, mistakes that could not be detected without breaking the work. Not only can various shafts be accommodated, but other and entirely different parts can be heat-treated with but slight changes in the work-handling mechanism.

Development Activity in the Metal-Working Industry

A SURVEY recently completed by *Product Engineering* to determine design trends in various industries gives some interesting data on metal-working machinery. This group was represented by 66 manufacturing companies comprising machine tool builders, special machinery manufacturers of small tools and hand tools used in the shop, and seventeen manufacturers representing rolling mill, forge shop, foundry and similar equipment. Their development activity, over the past two years, is shown by the following tabulation:

RELATIVE DEVELOPMENT ACTIVITY

	Companies
Activity greater than 1931	16
Activity greater than 1932, first half	22
Activity less than 1931	25
Activity less than 1932, first half	24
Constant activity throughout above period	7
Contemplated increased activity	16
No change in activity contemplated	37
Increased product development program	16

NUMBER OF MEN EMPLOYED

	Heavy Equipment Industry	Machine Tool Industry
1931, first half	918	327
1931, second half	711	300
1932, first half	398	299
Present time	292	245

According to the above tabulation, there has been a drop of about 68 per cent in engineering personnel in the seventeen companies representing equipment for foundries, rolling mills, forge shops, and similar machinery. This group includes some of the largest manufacturers of this type of equipment in this country, and it is significant that if those companies whose engineering personnel now exceeds 20 men be omitted from the tabulation, the decrease in personnel is only 34 per cent, or exactly one half of the drop for the whole group. However, even this represents a loss almost 50 per cent greater than that suffered by the machine tool industry, which shows a decrease of 26 per cent in engineering personnel for the period. Considering all of the above 66 companies, nine increased their personnel and seventeen had the same number of men throughout the different periods.

It is not surprising that the machine tool industry should show a relatively better condition than that indicated by the manufacturers of heavy equipment. A study of the other groups of manufacturers reported on in this survey clearly shows that manufacturers of medium sized metal products, household equipment in particular, have not suffered a loss in business to such a great extent as the manufacturers of heavy equipment. This is particularly striking when in each field the largest companies are left out of consideration. Apparently, the relatively continuous production in the smaller and medium sized plants engaged in the manufacture of these mechanical-electrical consumer products compels these companies to maintain their equipment, providing a market for machine tool builders.

In view of the state of this metal-working equipment industry taken as a whole, as shown by the product development activities, some of the items in the following tabulation of the general character of product development activities, have a special significance.

GENERAL CHARACTER OF PRODUCT DEVELOPMENT

	Companies
New products in present line	51
New products in new lines	22
Designs for higher price class	20
Designs for lower price class	28
Redesigns chiefly for lower manufacturing costs	34
Designs to provide a greater number of styles or sizes	18
Designs to widen the range of use of the machine	28
Reduced number of styles and sizes	18

A breakdown of the above tabulation shows that almost one half of the manufacturers in the heavy equipment fields are developing new products in new lines, possibly being forced into doing so by the dearth of business in their present line of products. On the other hand, less than one third of the manufacturers of machine tools are placing particular emphasis upon the development of products in new lines.

The manner in which the machine tool and equipment industry is striving to meet the requirements of its customers is indicated by the following table:

DESIGN FACTORS EMPHASIZED

	Companies
Higher speeds of operation	37
Higher capacity units	30
More automatic operation	35
Greater precision in use	36
Decreased power consumption	19
Improved gearing	31
Better electrical control	33
Devices or materials to minimize vibration	23
Improved lubrication	45
Adoption of corrosion-resisting materials	35
Improved lock washers and locking devices	12
Closer manufacturing tolerances	30
More easily replaceable units	30
Restyling for new form	30
Better surface finish	15
Improved color scheme	4
Materials adopted for improved appearance	12

It is naturally to be expected that the first five items in the above tabulation should receive great attention, these being fundamental factors underlying the design of the equipment. It is, however, interesting to note the order of importance attached to the various design items. Thus, improved lubrication, stressed by 45 of the companies in this group, is receiving the greatest attention, with corrosion resisting materials, better electrical control, improved gearing, closer manufacturing tolerances, more easily replaceable units, and restyling for new form, following in the order given.

Further details are included in the November number of *Product Engineering*.

Pump Barrel Production

HENRY C. FRANCIS

A western shop employs some novel methods on oil-well pump parts

OIL-WELL pumps have been considerably standardized as to design, but methods of manufacture vary with the plant in which they are made. Pump barrels are made of cast-iron sections 12-in. long and of varying diameters according to the capacity desired. These sections are made accurately, concentricity being an essential feature, as a number of them are held end to end in a tube. A short outside bearing on each end fits the outer tube. The sections must line up precisely to secure the proper fit for the plunger. The sections are cast separately and are bored and lapped for the plunger. A few of the operations are performed on special machines, but for most of them, standard lathes have been equipped with fixtures especially adapting them to this work.

Both ends of the rough casting are first faced on the special machine in Fig. 1. The casting is located by plates at either end which are swung down in front of the facing cutters while the piece is being put into the machine. The work is held in V-blocks at each end by a heavy spring at the top which acts through the toggles shown, thus allowing for variations in the diameters of the rough castings. An air cylinder at the back of the machine releases the toggle clamp and compresses the spring. After the work is centered and clamped, the locating gage is raised and cutters are fed in from each end to face the section to approximate length.

Next the outside of each end is turned on the lathe in Fig. 2. This lathe has an air-operated tailstock and chuck. A special fixture on the carriage has V-blocks for holding the section until the tailstock clamps it in place. The tool block carries tungsten-carbide cutters controlled by the air cylinder at the back, the crossfeed screw having been removed.

A special vertical drilling machine, Fig. 3, built up from a channel beam and plates cut to support and position the work, serves to drill a dowel hole in

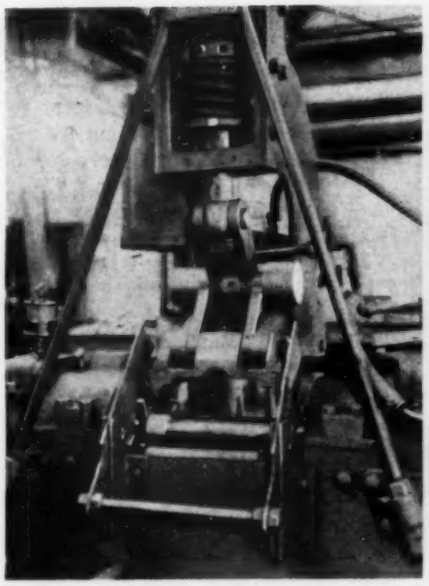


Fig. 1—Ends are faced in a special double-head milling machine using a spring-actuated clamp

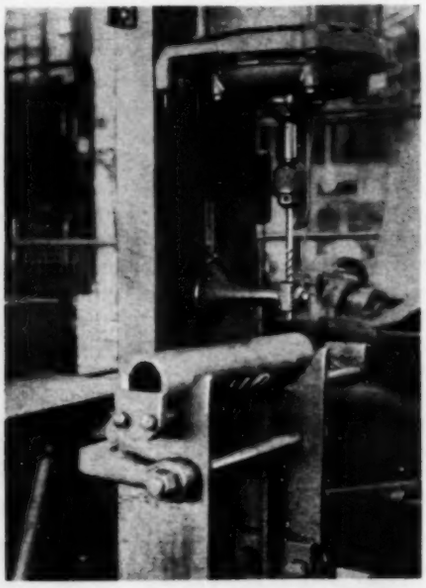


Fig. 3—Dowel holes are quickly drilled in an improvised machine made of structural shapes

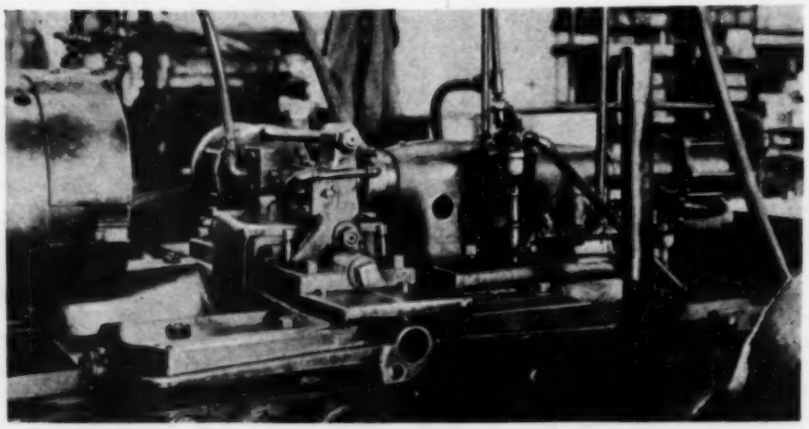


Fig. 2—A pneumatically operated tool rest is used to turn the ends

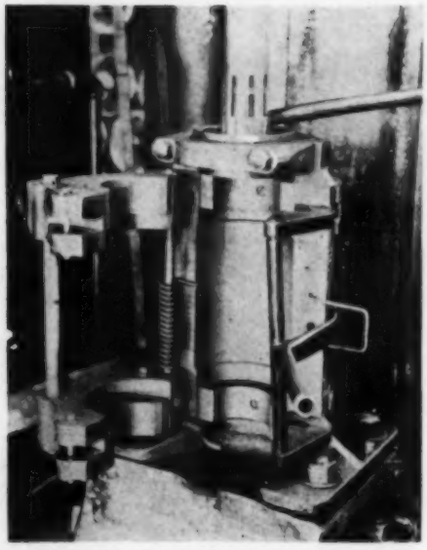


Fig. 4—Barrel sections are rough bored in a hinged locating fixture

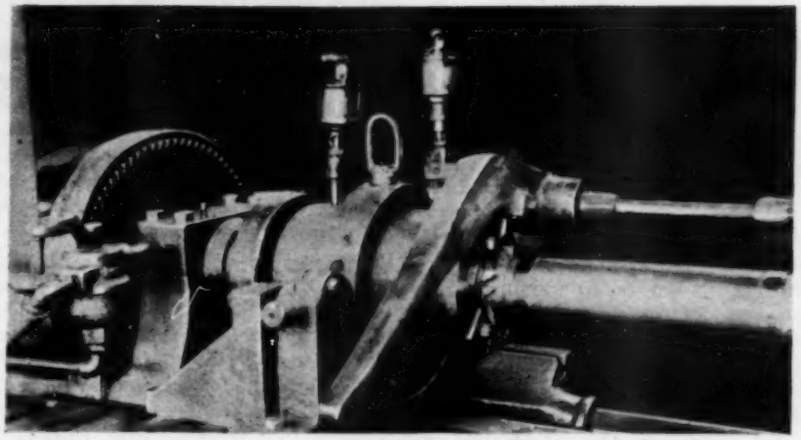


Fig. 5—Final facing and chamfering is done on a made-over lathe with the work held on a mandrel revolving inside the cutter head

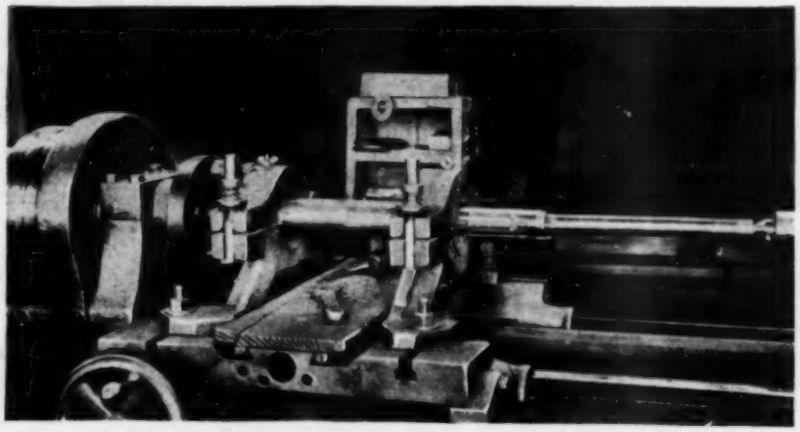


Fig. 6—With the work held in a special fixture, the bore is reamed by a rotating tool

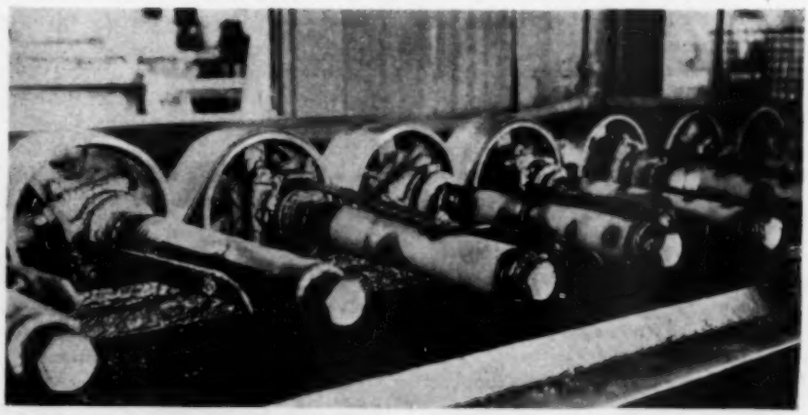


Fig. 7—Laps are reciprocated while the work rotates in this multiple-spindle machine

one end for use in future operations. The drill chuck is mounted directly on the end of the motor shaft, while the drill is guided just above the work so that no fixture is necessary beyond the V-blocks and the end stop. The three machines mentioned are set on three sides of a square so that the pieces pass directly from one to the other with minimum handling.

Across the aisle are the heavy-duty drilling machines that rough-bore the barrel sections. The dowel hole locates the work in the hinged fixture in Fig. 4. The hinged portion is swung open automatically by the spring and is quickly and securely fastened both top and bottom by an easily operated latch. A rod on the hinged portion makes it easy to close the hinged part of the fixture.

Another modified lathe is shown in Fig. 5 where an air-operated expanding mandrel holds the pump liner for final facing and chamfering. The mandrel revolves inside the head carrying the facing tools. A bevel-pointed tool in an overarm that swings downward chamfers the outer corner of the shell as it revolves. Length is gaged by a sensitive dial indicator supported at the right of the sleeve. This enables the operator to hold the dimension within close limits.

The sleeve is held in quickly operated clamps mounted on a lathe carriage while the bore is reamed ready for lapping, as in Fig. 6. Here too the dowel hole locates the sleeve and prevents it from turning without the necessity for tight clamping at the ends. Bores are next lapped on the multi-spindle machine in Fig. 7. A pin near the end of a flat spring drops in the dowel holes and revolves the liner while the lap remains stationary inside it. These liners are driven by a continu-

Fig. 8—Final inspection is expedited by gages supported in a rack

ous belt over and under the pulleys at the rear. The laps are hollow and perforated in order to feed water and abrasive to the work as needed. There is also an end motion to prevent scoring the bore of the sleeves.

After leaving the lapping machine, the sleeves are placed in a basket or frame, which hangs from a pneumatic hoist on an overhead rail. When filled, it is lowered into a tank of hot cleaning solution to wash out the abrasive. After being raised from cleaning tank, each sleeve is cleaned with a brush by hand, and the sleeves go into a tote box to be carried to the inspection department for gaging.

Before gaging, however, they are cooled to room temperature by the blast of air from an electric fan. This also aids in drying the sleeves, although they dry quickly after the hot cleaning bath. This operation was adopted to prevent gaging of sleeves affected by unequal temperatures.

Final inspection is done by standard gages fastened to a rail, Fig. 8, one sleeve being shown in place. These gaging plugs are held in the flanges by a set screw and can easily be removed for repair or replacement. "Go" and "not-go" gages, differ by 0.0005 in. from the nominal diameter. Tolerances are close, both as to diameter and straightness. Gage plugs of different sizes may be seen behind the sleeves. When not in use, the plugs are covered with jackets.

These illustrations show the practice of the D. & B. division of the Emsco Derrick & Equipment Company, Los Angeles, Calif., and were secured through the courtesy of Edward E. Stevenson, manager of this division.

Spot Welding Rustless Steels

V. W. WHITMER
Metallurgist, Republic Steel Corporation

Rustless steels are particularly well adapted to spot welding because of their clean surface, freedom from oxide or scale and because of the absence of any coating such as zinc or lead, as on galvanized or terne plate stock.

Spot welding, in principle, is nothing more than holding two sheets in close contact between two copper electrodes about on inch or so in diameter with the contact ends tapered to about ⅛ in. in diameter, and passing a current, low in voltage but high in amperage, through the circuit for a short period. Fusion immediately takes place between the two sheets, while the excess heat is rapidly carried away from the outside surfaces by the water-cooled electrodes. The low voltage, about two to four volts, is obtained from a step-down transformer wound in sections, each being connected with a stop on a rotary control switch by which the current or heat can be increased or decreased.

While the total heat applied will be determined by the rotary adjustment, the area of the electrode points should be maintained as near constant as possible. Any increase in area will tend to reduce the heat per unit area, resulting in an improperly or poorly fused joint. A decrease in area will increase the unit heat and will usually burn a hole entirely or partly through the sheet to be welded.

The pressure exerted by the electrodes is generally produced by the compression of helical springs and can be adjusted by a lock nut on a shaft through the center of the spring. Variable pressures will also affect the quality of the weld. Too much pressure will reduce the resistance of the joint and hence tend to decrease the heat generated. The pressure generally determines the amount of upset displacement directly following the fusing period, producing an indentation on each side of the sheets welded.

In addition to these variables, the time of current flow is of great importance. Too long a period gives the same result as too much heat. Too short a contact will produce no weld.

It is evident, therefore, that spot welding depends on the following four variables:

1. Current (controlled by rotary switch).
2. Diameter of electrode contact points.
3. Pressure (controlled by spring or pneumatic pressure).
4. Length of time the current is allowed to flow.

While it would not be impossible to determine an adjustment of each of these with respect to the other for each gage to be welded, as in the case of automatic machines where time and pressure are accurately controlled by motor-driven cams and the current set by hand, it would be next to impossible to determine them for manual operation, because of the personal element. Furthermore, such adjustment would be necessary for each individual machine. This makes it impossible to set up any specific procedure to follow for this class of work. However, rustless steel in general will require less heat than the same gage in common steel, because of its lower heat conductivity (tending to concentrate it in one spot), its lower melting point and better contact because of a scale-free surface. Consequently, if an operator is producing good work on say twenty-gage black steel, he could, in general, change to the same gage rustless by either dropping the switch one point or reducing the time slightly, or both. More definite instructions cannot be given but the exact procedure must be worked out.

Removing Indentations

If both electrodes are of the same diameter, a depression will occur on both sides which, while not serious on the pickle finishes, may be objectionable on the polished surfaces. This can be reduced by using a copper block about ½ in. thick and 2 in. square between the electrode and polished side, thus putting the major depression on the lower side. An aluminum block ⅛ in. to ¼ in. works even better but because of its lower melting point, will tend to pit if a slight arc is drawn. This procedure will reduce the depression but will not eliminate it entirely, as it is caused by shrinkage of the molten metal in the center and, hence, pulls from both surfaces. The indentation remaining, if the work is to be polished, will have to be ground out with a cotton wheel set up with glue and abrasive. (Use about 80 grit or finer).

Spot welding, like any other type of welding requiring high temperature, will form an oxide on the surface which will be blue in color. If this is exposed to the weather or moist conditions, it will slowly change to a brown color resembling rust. This, however, is only a surface condition, affecting the original oxide only. If such welds are to be exposed to the atmosphere, they should be cleaned either with acid as in pickling in the case of No. 1 finish sheet, or ground and polished if No. 4 or higher finishes are employed. In the ground and polished state, spot welds are just as resistant to the salt spray as the original metal.

Contour Calculations for Forming Tools—VII

O. A. JOHNSON
Chief Tool Designer,
Tyson Roller Bearing Corporation

Internal circular forming tools, set and fed at an angle to the work axis, are analyzed

MACHINING internally the part shown in Fig. 46 by the ordinary method of boring would be slow, inaccurate and difficult compared to the more up-to-date method of using forming tools.

We shall calculate a circular finishing tool for forming this job. When determining the setting angle and the feed angle of the tool, the following conditions should be considered:

1. Angle *B1*, Fig. 47, should not be less than 10 deg.

2. Angle *B1* should be large enough so that the tool when retreating will not interfere with the opposite side of the work.

3. Angle *B1* should not be unnecessarily large, or the difference between the extreme diameters on the tool will be too great.

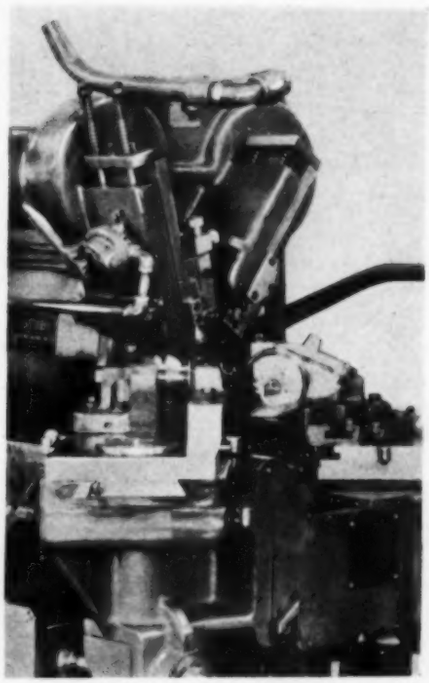
The undercut or grinding relief should be determined, if possible, after the setting and feed angle has been fixed so that both sides of the nib on the tool, which forms this undercut, is tapered about 10 deg. (see Fig. 50). When deciding on the periphery clearance angle, we will be on the safe side by making this angle not less than 12 deg. and not more than 15 deg. as for external tools feeding at an angle. The distorted rake angle *B16*, Fig. 48, should be about 20 deg., variable for different kinds of steel to obtain good results. The diameter of the tool should not be over three-quarters of the smallest diameter to be formed.

Whenever possible, it is better to use an internal circular forming tool feeding at an angle than a tool feeding at 90 deg., because only one movement of the tool is required. When using a tool feeding at 90 deg., the tool must first feed in along the center line of the work and then feed radially.

In Fig. 47 is a section of the work with the tool in finished position. It is obvious that the longest surface of the cutting edge will have to cut on center of work, and in order to accomplish this, the rake angle should be ground at an angle with the center line of the tool. As explained in preceding articles, we have to establish a base line *A-A* on the product. All points to be calculated should be numbered, and lines should be drawn from these points perpendicularly to the center line of the work until they intersect the base line. These new imaginary points will then all fall on the center of the work. If we locate these points on the center line in Fig. 47 and draw lines with the distorted rake angle *B16*, we will get the true location of the individual points at the intersections of these lines and the respective circles. Fig. 49 is the end view of the tool and Fig. 50 is the tool profile.

The tool calculations are indicated below. In deriving actual tool dimensions, the use of five-place logarithmic tables is recommended. For the method of procedure see the first article of this series (*AM*—Vol. 76, page 896).

$B1 + A1 = B2$
$A28 \times \cos B2 = B3$
$B4$ = rake angle
$B5$ = periphery clearance angle



A Sundstrand set-up combines one internal and two external forming tools

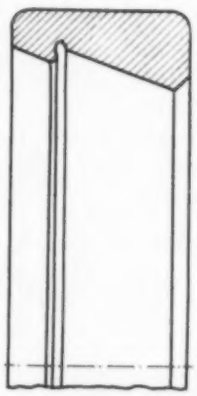


Fig. 46—A product like this provides a typical application for an internal forming tool

$B4 + B5 = B6$
$B6$ = included rake angle
$A28 \times \sin B2 = B7$
$B7 \times \sin B4 = B8$

$$\frac{B8}{B3} = \tan B9$$

$B9$ = vise angle
$B10$ = radius of tool at $P1$
$B10 \times \cos B5 = B11$
$B11 - B7 = B12$
$B10 \times \sin B5 = B13$

Fig. 47—This section through the axis of the work shows the tool in finished position

$\frac{B13}{B12} = \tan B14$

$\frac{B12}{\cos B14} = B15$

$B15$ = radius of tool at $P2$

$\frac{\tan B4}{\cos B1} = \tan B16$

$B16$ = distorted rake angle

$A40 \times \sin B16 = B17$

$\frac{B17}{\tan B16} = B18$

$\frac{B17}{A43} = \sin B19$

$A43 \times \cos B19 = B20$
$B20 - B18 = B21$
$B21 \times \cos B16 = B22$
$B22 + A40 = B23$
$A43 - B23 = B24$
$B24 \times \cos B1 = B25$
$B26 - B1 = B27$
$A44 \times \sin B27 = B28$
$B28 - B25 = B29$
$B29 + B12 = B30$
$B22 \times \tan B16 = B31$
$B13 - B31 = B32$

$\frac{B32}{B30} = \tan B33$

$\frac{B30}{\cos B33} = B34$

$B34$ = radius of tool at $P3$
$B34 - B15 = B35$
$B10 - B15 = B36$

$\frac{B36}{B3} = \tan B37$

$B24 \times \sin B1 = B38$
$A44 \times \cos B27 = B39$
$B39 - B38 = B40$

$\frac{B35}{B40} = \tan B41$

$B41 + B37 = B42$

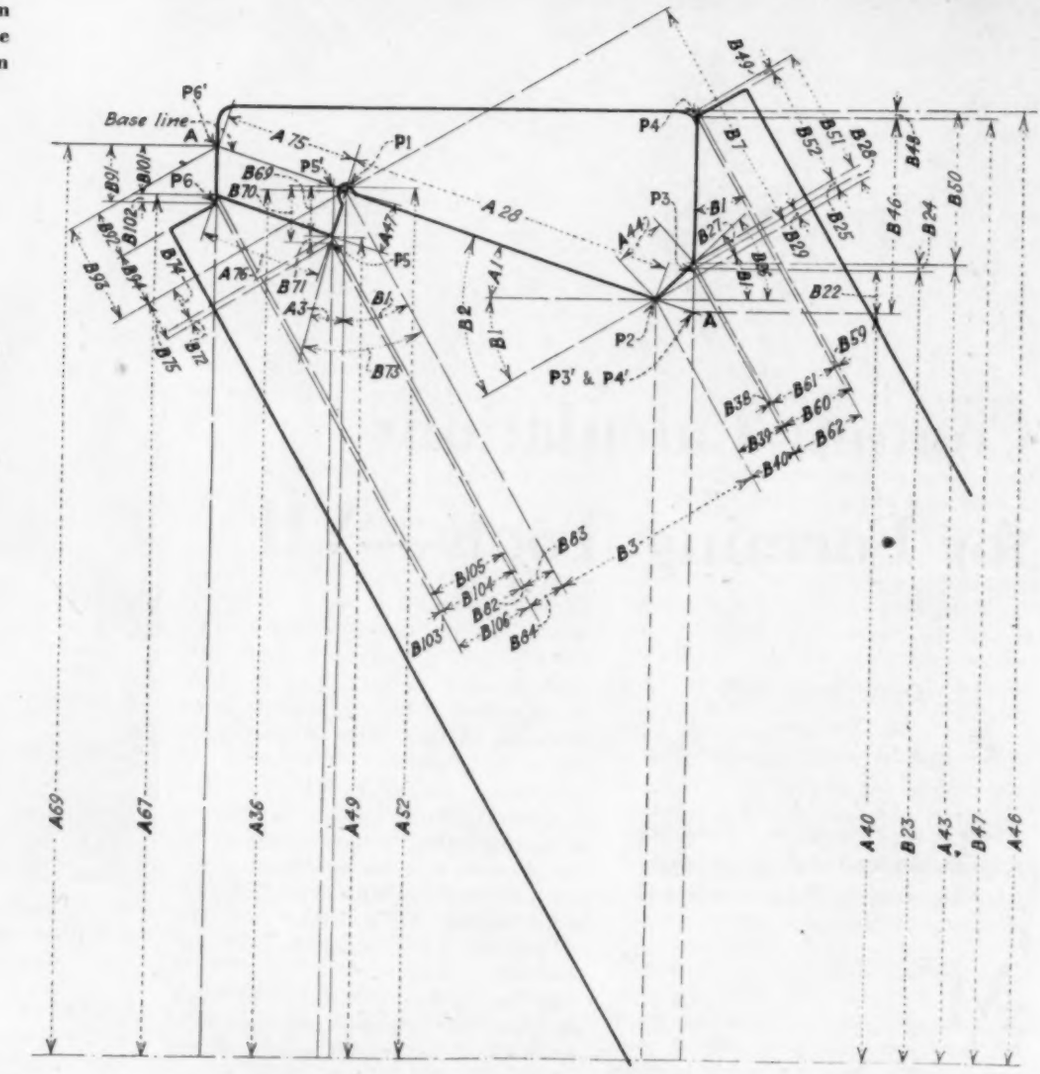
$\frac{B17}{A46} = \sin B43$

$A46 \times \cos B43 = B44$
$B44 - B18 = B45$
$B45 \times \cos B16 = B46$
$B46 + A40 = B47$
$A46 - B47 = B48$
$B48 \times \cos B1 = B49$
$A46 - A43 = B50$
$B50 \times \cos B1 = B51$
$B51 - B49 = B52$
$B52 + B28 + B12 = B53$
$B46 \times \tan B16 = B54$
$B13 - B54 = B55$

$\frac{B55}{B53} = \tan B56$

$\frac{B53}{\cos B56} = B57$

$B57$ = radius of tool at $P4$



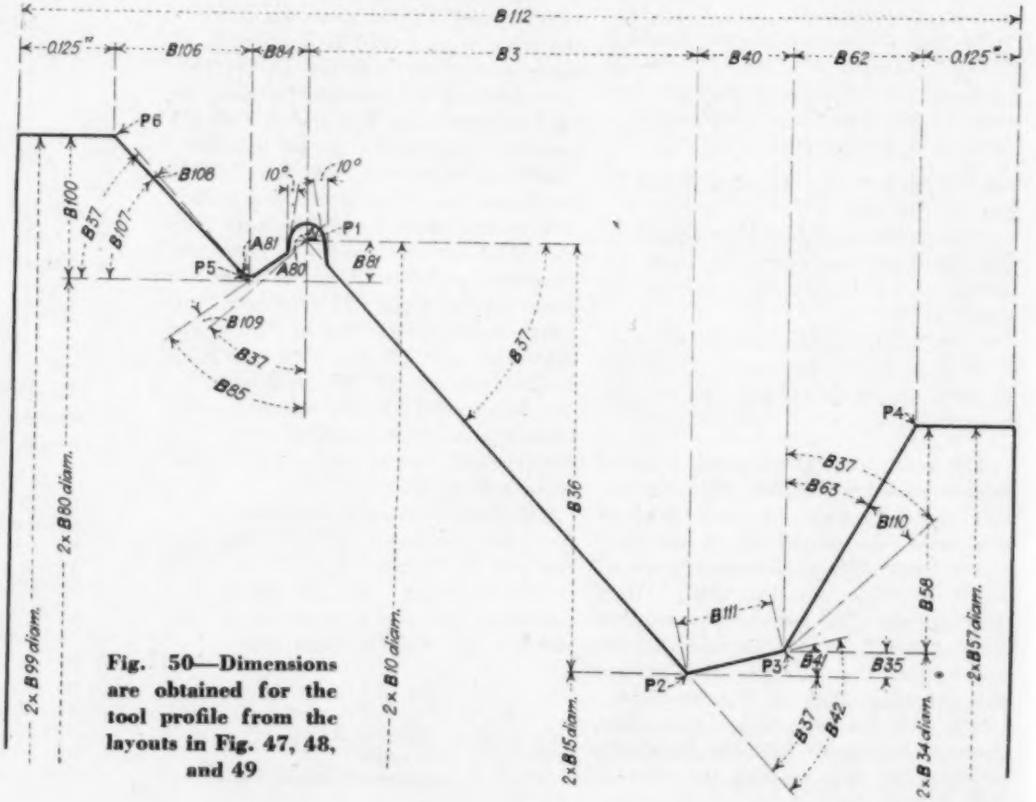


Fig. 50—Dimensions are obtained for the tool profile from the layouts in Fig. 47, 48, and 49

$B57 - B34 = B58$
$B48 \times \sin B1 = B59$
$B50 \times \sin B1 = B60$
$B60 - B59 = B61$
$B61 + B38 = B62$

$$\frac{B62}{B58} = \tan B63$$

$A52 \times \sin B16 = B64$

$$\frac{B64}{A49} = \sin B65$$

$A49 \times \cos B65 = B66$
$A52 \times \cos B16 = B67$
$B67 - B66 = B68$
$A52 - A49 = B69$
$B68 \times \cos B16 = B70$
$B70 - B69 = B71$
$B71 \times \cos B1 = B72$
$A3 + B1 = B73$
$A47 \times \cos B73 = B74$
$B74 + B72 = B75$
$B11 - B75 = B76$
$B70 \times \tan B16 = B77$
$B77 + B13 = B78$

$$\frac{B78}{B76} = \tan B79$$

$$\frac{B76}{\cos B79} = B80$$

$B80$ = radius of tool at $P5$
$B10 - B80 = B81$
$B71 \times \sin B1 = B82$
$A47 \times \sin B73 = B83$
$B83 + B82 = B84$

$$\frac{B84}{B81} = \tan B85$$

$A69 \times \sin B16 = B86$

$$\frac{B86}{A67} = \sin B87$$

$A67 \times \cos B87 = B88$
$A69 \times \cos B16 = B89$
$B89 - B88 = B90$
$B90 \times \cos B16 = B91$
$B91 \times \cos B1 = B92$
$A75 \times \sin B2 = B93$
$B93 - B92 = B94$
$B94 + B11 = B95$
$B91 \times \tan B16 = B96$
$B96 + B13 = B97$

$$\frac{B97}{B95} = \tan B98$$

$$\frac{B95}{\cos B98} = B99$$

$B99$ = radius of tool at $P6$
$B99 - B80 = B100$
$A69 - A67 = B101$
$B91 - B101 = B102$
$B102 \times \sin B1 = B103$
$A76 \times \cos B2 = B104$
$B104 + B103 = B105$
$B105 - B82 = B106$

$$\frac{B100}{B106} = \tan B107$$

$B37 - B107 = B108$
$B85 - B37 = B109$
$B37 - B63 = B110$

$$\frac{B40}{\cos B41} = B111$$

$B3 + B40 + B62 + B84 + B106 + 0.250$ in. $= B112$

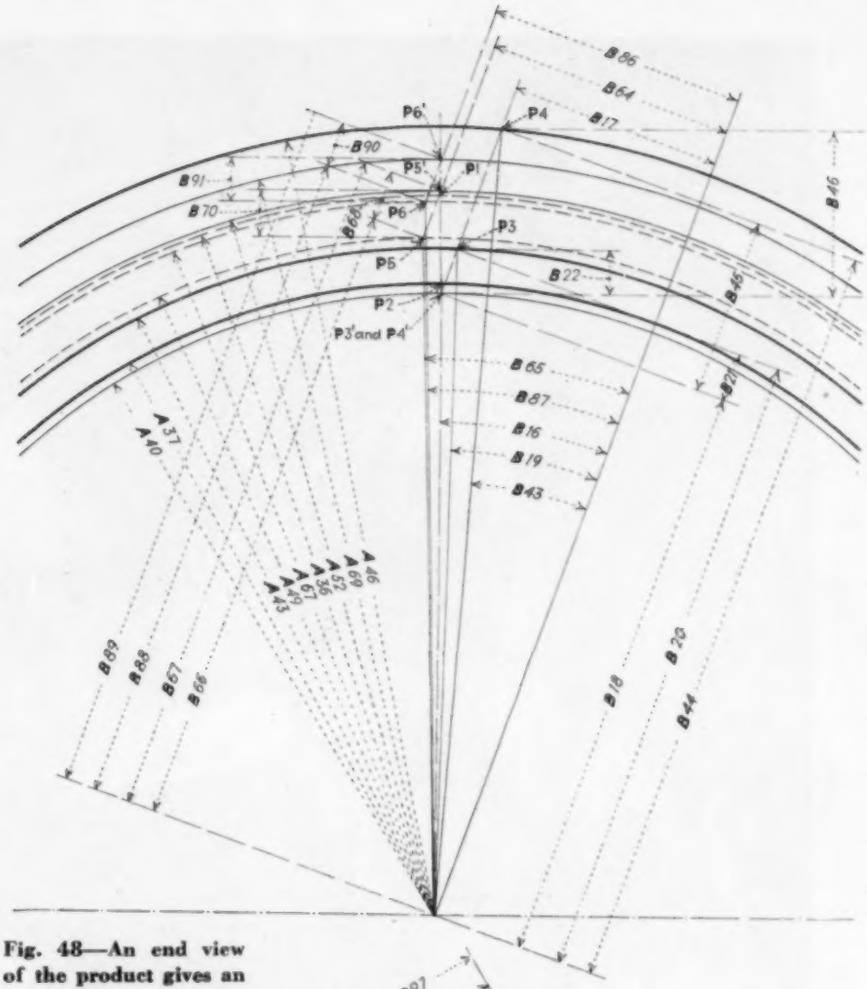


Fig. 48—An end view of the product gives an angular view of the tool. Dimensions must be projected into the plane of Fig. 50 to find their true value.

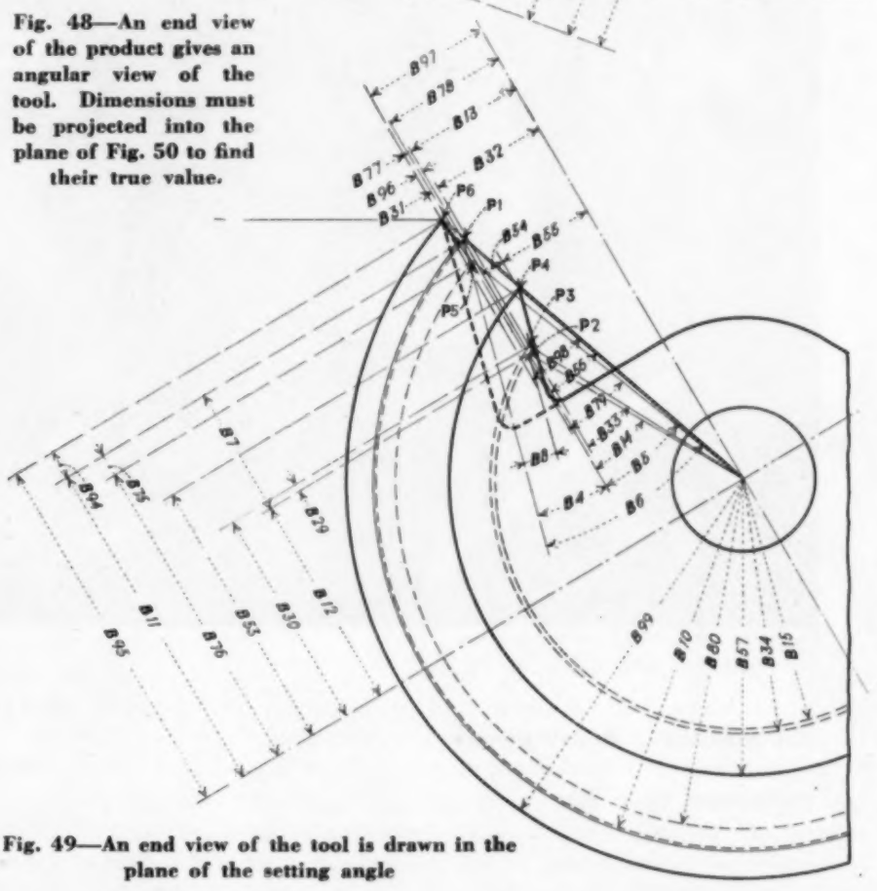


Fig. 49—An end view of the tool is drawn in the plane of the setting angle

Courtesy Worthington Pump & Machinery Corporation *Photo by Rittase*

Many holes in many pieces

patterned to a jig

EDITORIALS

AMERICAN MACHINIST
VOLUME 76 ESTABLISHED 1877 NUMBER 34
McGRAW-HILL PUBLISHING COMPANY, INC.
K. H. CONDIT F. H. COLVIN
EDITORS

Spread the Work

Regardless of the outcome of the election or of any other factor that may effect business it is certain that this winter is going to be the hardest that many of us have ever known. We believe that there will be a steady but slow increase of industrial activity but we do not believe it will come fast enough to cure unemployment this year. Therefore, we urge every reader of *American Machinist* who has any influence at all to exert it in favor of the spread-the-work campaign of Mr. Teagle's committee.

From all reports the vast majority of metal-working plants are already on such short time that there is little chance to do any spreading of work. But in those fortunate exceptions where the plant is busy nothing will help so much as to spread that work among as many men as possible.

An Effort to Lower International Trade Barriers

Although most of us are somewhat cynical toward probable accomplishments by international conferences we are still sufficiently interested in selling our goods abroad to be concerned with any endeavor to lower the artificial barriers that have been set up to keep us out. There are enough natural barriers, in all conscience, without such political obstructions as exchange restrictions and import quotas.

Ever since the Lausanne Conference which settled the reparations question, so far as any likelihood of payment is concerned, plans for an economic conference have been maturing. Informed observers tell us that the time and the place of this conference depend, to a certain extent, on the outcome of the German election on November 6, and of our own of two days later. It is becoming increasingly apparent, however, that some of our European friends are in such desperate straits that the conference cannot be put off very long.

The proposed conference differs from the one held at Geneva several years ago in that the various countries will be represented by delegates with power to act. It is also different in that dire necessity has brought reasonableness to some who were the exact opposite of reasonable but a few months ago. Real results may therefore be anticipated.

Some people seem to think that our present tariff and our general tariff policy for many years are largely at fault. Neither is perfect, it is true. Yet how insignificant a barrier a tariff is compared to import quotas that can be slapped on over night, or exchange restrictions that make the completion of any kind of business transaction almost impossible. Business has always found a way over or around an obstacle that stays put, but it is helpless before one that appears or disappears, or shifts from one side to the other from day to day.

Our delegates will be well advised to do everything possible to stabilize trading conditions. They will also have constantly in mind that our own domestic market is of vastly more importance to American industry than the foreign market, or any part of it. Of this fact the efforts of other countries to get into it are adequate proof.

Product Development Activity

A comprehensive survey of activity in the field of metal product development occupies the major part of the November number of our companion paper, *Product Engineering*, which goes in the mail tomorrow. A summary of the portion of the survey covering metal-working equipment is printed on another page of this number of *American Machinist*.

Activity in developing new products is of primary importance to *American Machinist* readers on two counts: because new products usually mean additions to or changes in production equipment; and because the public acceptance of a new product means sales and orders and work in the shop.

When existing lines are redesigned—for better finish, for application of anti-friction bearings, for greater accuracy, for any one of a dozen other reasons—there is work ahead for the production department, because production methods may have to be changed to get the desired results.

The *Product Engineering* survey shows an amazing amount of activity in product development and is therefore a hopeful omen for production. It also contains a lot of information that will be useful to production men as well as to engineers.

Watch New Developments

Imagination plays its part in all inventions and in the development of new processes. Yet initial imagination seldom goes much beyond a specific and limited use for the device or product. The development of high-speed steel for tools prompted the experiments that resulted in Stellite and later in the tungsten-carbide alloys, as cutting tools. Both of these alloys

are now finding uses as inserts or wearing surfaces, where hardened steel does not stand up.

Gas and electric welding are also widening their fields of usefulness. Originally devices for patching defective castings or doing simple welding jobs, they are now used as a regular part of manufacturing operations. Die casting and the use of plastic materials are also extending their fields. First used in the making of small parts they have both grown until they are now an important factor in many industries.

Another interesting development with unknown possibilities is the photo-electric cell, or electric eye. Beginning with a few stunt applications such as counting entries through a passageway its usefulness is extending in many directions, one of the latest being in photo engraving.

Every new development of this kind is a burden on management. Or shall we call it a challenge? It imposes the necessity of studying its possible application to either the product or the methods of the plant. Failure to recognize either may spell disaster. Are we watching new developments of this kind as closely as we should?

• CHIPS •

Political campaign reaches the stage of personalities . . . distracts attention from favorable economic factors . . . Car loadings rise unseasonably . . . Securities markets recover somewhat and mark time . . . Robertson Committee pushes organization and reports progress in actual orders placed . . . stages enthusiastic meetings in Chicago, Milwaukee, Detroit . . . Teagle Spread-the-Work Committee begins active work . . . Relief drive on . . . Machine tool builders and dealers hold meeting distinguished by evidences of courage and confidence.

Riots in England may lead to modification of dole restrictions . . . British-Russian trade pact abrogated because of conflict with Ottawa Conference agreement . . . Unemployment less in Germany . . . Reichsbank president warns against import quotas as sure to provoke reprisals that would throttle exports and increase unemployment . . . France omits debt payments to U. S. from budget . . . Russia dedicates Dnieprostroy power plant . . . decorates Col. Cooper, American constructor . . . Montagu Norman full of gloom over world economic situation . . . British debt payment to U. S. due in about 60 days.

Output of electrical energy gains slightly . . . Steel companies cut rail prices $3 a ton . . . I.C.C. blocks Loree trunk link . . . Railroad Credit Corporation will terminate activities early in 1933 . . . new one may be formed . . . Bank position stronger . . . acceptances increased over $1,000,000 in September . . . rise in bank clearings more than seasonal . . . Food index holds instead of following seasonal decrease trend usually exhibited at this period . . . Steel rate reaches 20 per cent.

Murray Corporation recalls 1,200, mostly tool makers . . . *Jamestown* (N.Y.) *Evening Journal* reports nearly nine per cent increase in employment in 50 plants since July 1 . . . Employment in Toledo plants double what it was late in August . . . September exports rise above August which was above July . . . Commissioner of Customs opens investigation on low-priced imports . . . Chrysler announces expenditure of $9,000,000 on design and re-tooling for new Plymouth Six . . . Commodity price index rose slightly in September . . . Pennsylvania R.R. announces assignment of car building to five of its shops . . . Photo-electric cell process of making engravings demonstrated in New York . . . reduces time and cost considerably.

Justice will be coolly dispensed in Washington . . . orders placed for air-conditioning equipment for the Supreme Court and Department of Justice buildings . . . First storage battery train having operated successfully on Great Southern Railway of Ireland, another one is ordered . . . Frigidaire sales in September up 43 per cent from August . . . G.E. ships eight carloads of oil burners to New York City . . . R.F.C. grants loan for bridge from San Francisco to Oakland . . . removes obstacles to loan for traffic tunnel from 38th St., New York City, under Hudson . . . Textile activity continues at a high level . . . large orders for machinery placed by southern cotton mills . . . rayon mills active, buy motors . . . Perfection Stove Co. increases force from 250 to 600 . . . Byers Machine Co. adds to force and to hours . . . Iron Fireman Manufacturing Co. reports October orders 53 per cent ahead of last year.

> An important part of any rehabilitation movement is the removal of the obsolete excess capacity. It can be done, despite the reluctance of tradition-bound executives. Witness the reduction of flour milling capacity in one district in Minneapolis from 55,000 barrels in 24 hours to 22,000 barrels [*Food Industries*, October]. Also the scrapping of two idle blast furnaces at the Mayville plant of Youngstown Sheet and Tube Company and two Wharton furnaces of Bethlehem Steel Company. Aggregate annual capacity reduction—625,000 tons [*Steel*, October 24]

Iron Age reports no change in its composite prices of pig iron and finished steel . . . scrap loses September gains . . . Machine tool orders gained slightly in September . . . *Metal and Mineral Markets* reports slow business and few changes in non-ferrous metal prices . . . demand for lead improved and stocks diminished . . . zinc sales were better . . . copper and brass trade is on the increase.

Rehabilitation Program Presented to Machine Tool Men

Well over a hundred machine tool builders and dealers met at Swampscott, Mass., last week and heard A. W. Robertson, chairman of the board of the Westinghouse E.&M. Co., and chairman of the industrial rehabilitation committee tell about the events leading up to the formation of this committee and the principles which it is promulgating. Details of the coordinated modernization campaign of the Associated Business Papers and of the organization and activities of the Robertson committee were presented to the builders by Mason Britton, vice-president, McGraw-Hill Publishing Co., Inc., and to the dealers by K. H. Condit, editor, *American Machinist*. Mr. Robertson, speaking at the joint dinner of the two groups, made a special point of the fact that his committee is advocating equipment purchases only where the purchaser can make an immediate saving in his production costs on jobs that are going through.

At the opening session of the meeting of the National Machine Tool Builders' Association, which ran from Oct. 9 to 11, President Gaylord commented on his findings after an intensive study of the financial structure of the industry. In normal times the sales amount to 80 cents for each dollar of invested capital, a turnover of about 4/5. The industry is situated north of the Ohio River and east of the Mississippi, and its major market is in the same area. About 60 per cent of the product is sold directly, 40 per cent through dealers.

Of particular interest was a chart shown by Mr. Gaylord to prove that machine tool sales follow the general business curve very closely. The longest lag is 60 days. This chart refutes the old idea that machine tool sales are the first to drop off in a depression and the last to recover.

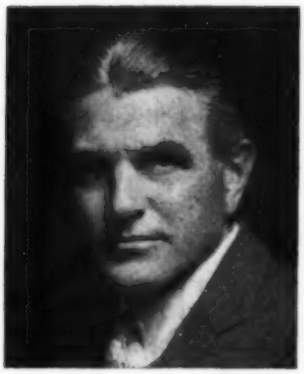
Commenting upon association activities, the new general manager, Herman H. Lind, observed that in an industrial fight to determine the survival of the fittest it is not certain that the fittest will survive nor that the survivors will be fit after the fight.

A discussion on pricing policy during depression periods was led by H. S. Beal, general manager, Jones & Lamson Machine Co. Mr. Beal commented on the unsatisfactory profit record of the industry and observed that during the last year prices of special machinery had been reduced while those of standard machines had been altered little. In the prepared discussion that followed, A. J. Gifford, treasurer, Leland-Gifford Co., suggested that the time will come when special machinery will be furnished on a cost-plus basis.

L. S. Horner, vice-president, The Bullard Co., outlined the program of the Teagle "share-the-work" committee. A resolution was passed indorsing this movement and urging association members to cooperate wherever possible.

Prof. E. H. Schell, Massachusetts Institute of Technology, talking on "Tomorrow's Problems in the Machine Tool Industry," called attention to these trends: the tendency to think of a plant by the product rather than by departments or operations; the trend toward the use of mobile units in job shops, and the indicated need for a new type of machine tool for this work; the growing interest in motion study work; the starting up of small shops by executives who have been forced out of old companies by retrenchment measures.

Hon. Marcus A. Coolidge, Senator from Massachusetts, and president, Seneca Falls Machine Co., spoke briefly on conditions in Washington and said that some form of manufacturers sales tax would probably be passed at the next session of Congress.



HENRY S. BEAL
President-elect, N.M.T.B.A.

The other speaker at the joint dinner was Ambrose Swasey, surviving founder of the Warner & Swasey Co. Mr. Swasey gave entertaining reminiscences of some of the outstanding early machine tool builders whom he had known.

At a joint meeting of builders, closer cooperation of builders and dealers was urged by J. R. VanDyck, VanDyck Churchill Co.; time sales were discussed by E. P. Blanchard, sales manager, The Bullard Co.; the value of the trade acceptance movement by L. S. Horner;

• INDUSTRIAL REVIEW •

Machinery orders in October, like most other business responded to seasonal improvement factors. While business placed during the month was hardly satisfactory in volume it was at least better than for several months. Several orders have been won on prompt delivery, indicating bad order equipment that should be replaced, and must be when it fails. High hopes are entertained for 1933 business.

New York, for the first time in months, reports the placing of several real orders, and the existence of good prospects for closures in the next week or two. Philadelphia is cheered by a few orders, one for a large horizontal boring machine, but is somewhat disturbed by the low prices realized at auctions in Philadelphia and nearby cities. Boston says that orders are more numerous, but most of them pretty small.

Pittsburgh also is encouraged by some small orders. One dealer received an inquiry from a railroad for a machine that was under consideration in 1929. Cleveland reports that October will be better than September and expects further improvement in November. 1933 is anticipated as a time of real activity. In Detroit the feeling is that things are distinctly better. The new doughnut tires have led to orders for balancing machines for the wheels on which they are mounted. Inquiries are goods and expectations of early closure on some of them are confident. Die shops are busy, tool shops expect to be shortly.

Cincinnati does not find much cause for rejoicing. General business is improving but equipment orders lag. Indianapolis seems to be in much the same frame of mind. Chicago has some orders to report for the first time in weeks but is uncertain whether they indicate a real change in trend. Milwaukee is all stirred up by reason of a meeting of industrialists at which A. W. Robertson, Malcolm Muir and the Republican candidate for governor, Walter J. Kohler, talked rehabilitation. Some of those present were so enthused that they rushed back and started to look over their equipment for possible replacement. Enthsiastic meetings in the rehabilitation drive were also held in Chicago and Detroit.

selling machine tools, 1907-1932, by Harry Barney, Barney Machinery Co.

At the dealers' meeting which was held on Oct. 11-13, discussion turned to the position of the dealer in the current distribution picture. Addresses were made by L. H. Swind, Swind Machinery Co., J. H. VanDeventer, editor, the *Iron Age*, and H. W. Barclay, editor, *Mill and Factory*.

The dealers re-elected their present officers: W. K. Stamets, William K. Stamets, Pittsburgh, president; H. E. Otis, National Supply Co., Toledo, vice-president; Harry Barney, Barney Machinery Co., Pittsburgh, secretary-treasurer. The following new members of the executive committee were elected: E. R. Motch, Sr., Motch & Merryweather, Cleveland; F. B. Scott, Jr., Syracuse Supply Co., Syracuse; J. R. VanDyck.

The builders elected to their board of directors; J. G. Benedict, treasurer and general manager, Landis Machine Co.; H. H. Pease, president, New Britain Machine Co.; Chas. J. Stilwell, vice-president, Warner & Swasey Co. The new board organized by electing these officers: Henry S. Beal, general manager, Jones & Lamson Machine Co., president; E. A. Muller, president, King Machine Tool Co., 1st vice-president; R. A. Heald, treasurer, Heald Machine Co., 2nd vice-president; F. H. Chapin, president, National Acme Co., treasurer.

New England Mobilizes for Recovery

In Boston, November 17-18, the Eighth New England Conference will be held. Its efforts will be devoted to organizing this section to accelerate economic progress. Delegates are expected from agricultural, commercial, and industrial organizations in all New England states. The Council's money-saving campaign in the reduction of public expenditures will be cited.

25.4 Ratio of Inch-Millimeter Conversion

A conference on the adoption of the value of 25.4 as the national standard conversion ratio between the inch and the millimeter was held under the auspices of the American Standards Association on October 21. This ratio has the advantage of cutting out four decimal places with an error of only two-millionths of an inch per inch from the theoretical, making it perfectly satisfactory for industrial use. C. E. Johansson, of gage block fame, demonstrated the minuteness of the effect of the change. Tables have been prepared giving conversions of inches to millimeters, millimeters to inches, and binary fractions of an inch to millimeters. The conference adopted the ratio.

Canadian Tariff Hits U. S. Metal Products

Changes in duties designed to increase the margin of preference enjoyed by the products of the British Empire in Canadian markets were presented at Ottawa by Premier Bennett on October 12 and became provisionally operative on October 13. This action is a result of the Imperial Economic Conference held at Ottawa in August.

On 133 of the 262 products involved, the increased margin of preference to British products is accomplished through reducing or removing the former British preferential duties. On over half the items, the additional advantage is arranged through increases in the intermediate tariff rates affecting countries having commercial treaties with Canada or in the highest scale of duties which applies to the United States and other non-treaty countries.

The following are the more important rate changes on manufactured metal products:

Comparison of Old and New Canadian Tariff Rates Applying to U. S.—and British Preferential Rates

Tariff Item	Commodity	General Rates (Apply to U. S. and Other Non-Treaty Countries) New	General Rates (Apply to U. S. and Other Non-Treaty Countries) Old	British Preferential Rates New	British Preferential Rates Old	Increased Margin of Preference
393	Tires of steel, in the rough for railway vehicles	10%	7½%	No change	Free	2½%
394	Axles and axle bars, and axle blanks, and parts thereof, of iron or steel: (a) For railway vehicles	No change	30%	10%	20%	10%
401	Wire, of iron or steel: (a) Barbed fencing	10%	Free	No change	Free	10%
	(d) Coated with zinc or spelter, in coils, .044, .104 or .092 in. in diameter, not for use in telegraph or telephone lines	10%	Free	No change	Free	10%
406	Coil chain, coil chain links, and chain shackles, of iron or steel: (b) Less than 1 ½ in. in diameter	25%	20%	No change	15%	5%
407	Chains, of iron or steel	35%	30%	No change	20%	5%
408	Malleable sprocket chain, and link belting chain, of iron or steel, when imported by manufacturers of agricultural implements	10%	Free	No change	Free	10%
409	Cream separators and complete parts therefor	25%	Free	No change	Free	25%
410-1	Ore and rock crushers, stamp and grinding mills, percussion coal cutters, coal augers, rotary coal drills, and parts thereof	25%	20%	7½%	10%	7½%
410n	Coal cutting machines	10%	Free	No change	Free	10%
412a	Electrotyping and stereotyping apparatus	10%	New item	Free	New item	.....
412b	Flat-bed cylinder printing presses, to print sheets of a size 25 x 38 in. or larger; machines designed to fold or sheet-feed paper	15%	10%	No change	Free	5%
412d	Offset lithographic and printing presses and type-making accessories	15%	10%	No change	Free	5%
414	Typewriters and complete parts therefor	No change	25%	Free	10%	10%
422b	Trench and ditch excavating machines, round wheel or vertical or ladder boom, chain and bucket type	15%	12½%	No change	Free	2½%
427b	Ball and roller bearings	No change	35%	5%	15%	10%
427e	Power churns, milk coolers, filters and cappers; ice cream mixers, butter printers, brine tanks, milk bottle washers, milk can washers, ice breaking machines, valveless or centrifugal pumps, and sanitary milk and cream vats	No change	35%	35%	Free	15%
428b	Engines for motor trucks and motor busses of 100 hp. or more	No change	27½%	Free	15%	15%
429b	Table knives and forks	35%	30%	15%	30%	20%
429c	Jack-knives and pocket knives	No change	30%	Free	20%	20%
429b	Knives n.o.p.	No change	30%	Free	20%	20%
429e	Spoons	No change	30%	15%	20%	5%
429f	Scissors and shears, n.o.p.	No change	30%	Free	20%	20%
429g	Razors and razor blades	No change	30%	Free	20%	20%
431b	Adzes, anvils, vises, cleavers, hatchets, saws, augers, bits, drills, files, rasps, screw-drivers, planes, spokeshaves, chisels, mallets, metal wedges, wrenches, sledges, hammers, crow bars, cantdogs and track tools, picks, mattocks	35%	30%	10%	15%	10%
438a	Passenger automobiles valued retail with equipment at more than $1,200 each but not more than $2,100	No change	30%	Free	15%	15%
438b	Passenger automobiles valued retail, with equipment at not more than $1,200; commercial motor cars and trucks	No change	20%	Free	12½%	12½%
c	Automobiles and motor vehicles of all kinds, n.o.p.	No change	40%	Free	18%	18%
d	Specified parts and accessories imported by manufacturers of motor omnibusses	Free	Varying	Free	Varying	.....
e	Motor cycles or side cars therefor	30%	20%	Free	12½%	22½%
440j	Trawls, trawling spoons, fly hooks, sinkers, swivels, sportmen's fishing reels	No change	30%	Free	20%	20%
441e	Guns and rifles of kind not made in Canada	No change	30%	5%	10%	5%
445c	Electric telephone and telegraph apparatus, and parts thereof	30%	27½%	Free	15%	17½%
445d	Electric wireless or radio apparatus and parts thereof	30%	27½%	Free	15%	17½%
445-1	Electric storage batteries composed of plates, not less than 11 by 14 in. and not less than ¼ in. thick	No change	27½%	Free	15%	15%
445m	Flame-proof electric switch gear for coal mines	No change	30%	Free	15%	15%
446	Electric steam turbo generator sets, 700 hp. and greater, of a kind not manufactured in Canada	25%	20%	No change	Free	5%
446b	Steel bicycle rims not enameled nor plated	No change	35%	Free	15%	15%
446c	Shafts of seamless steel, coated or not, but not chromium plated	No change	35%	10%	15%	5%
d	Bottles or cylinders of seamless steel used as high pressure containers	25%	35%	Free	15%	5%
e	Steel balls not larger than ¼ in. in diameter known as burnishing balls	10%	35%	Free	15%	10% (decrease)
783	Gasoline and steam engines, transmission assemblies, magnetos, starting motors, electric generators, propeller shafts, steel chassis frames, brakes, clutches, brake and clutch controls, steel road wheels, steel rims for pneumatic tires larger than 30 by 5 in., steering gears and axles, all of a kind not made in Canada	No change	20%	Free	15%	15%

Metal-Working Industry Backs Rehabilitation Move

As the Robertson Committee on Industrial Rehabilitation gathers momentum, many of the leaders of the metal-working industry have added their influence to the move by serving on the Federal Reserve district committees and the industrial center subcommittees. Among those heading Reserve District committees are:

First district—Boston: vice-chairman, Ralph E. Flanders, vice-president, Jones & Lamson Machine Co.

Second district—New York: vice-chairman, W. L. Batt, president, S.K.F. Industries, Inc.

Third district—Philadelphia: vice-chairman, Charles Brinley, president, American Pulley Co.

Fifth district—Richmond: chairman, W. H. Meese, vice-president, Western Electric Co.

Seventh district—Chicago: chairman, James D. Cunningham, Republic Flow Meter Co.; vice-chairman, Robert M. Gaylord, president, The Ingersoll Milling Machine Co.

Eighth district—St. Louis: vice-chairman, P. B. Postlethwaite, president, Wagner Electric Co.

Ninth district—Minneapolis: Frederic Crosby, vice-president, American Hoist & Derrick Co.

Tenth district—Kansas City: chairman, Frank Moss, president, American Sash & Door Co.

Eleventh district—Dallas: vice-chairman, R. C. Kuldell, president, Hughes Tool Co.

Twelfth district—San Francisco: chairman, J. A. Cranston, vice-president, General Electric Co.

Heading the industrial district subcommittees are the following:

Youngstown—Myron A. Arms II, president, Aetna Standard Engine Co.

Columbus—Edward Dorell, treasurer, Union Fork & Hoe Co.

Mansfield—Edwin M. Olin, vice-president, Westinghouse Electric & Mfg. Co.

Erie—P. A. Currie, vice-president and general manager, Erie Foundry Co.

Portland, Ore.—O. B. Caldwell, vice-president, Portland General Electric Co.

Machine Tool Orders Again Rise

Although the 3-months' moving average, upon which the National Machine Tool Builders' index is based, dropped from 30.3 in August to 27.7 in September, the most recent report showed an actual rise in orders. The August 3-months' average included the comparatively favorable month of June which is omitted from the September figure. A low point in orders reported was reached in July; the two succeeding months have shown a small but encouraging improvement.

The index of net orders is 29.3 for September and is made up as follows: Index A (base more than $50,000), 32.8; Index B (base $10,000 to $50,000), 12.6; Index C (base less than $10,000), 39.4. This compares with an average of 25.3 in July and 28.3 in August. Orders received by medium-sized firms decreased, while those for the large and small classifications increased.

Shipments during September rose decidedly from 29.9 in August to 42.5 which accounts for a drop in the index of unfilled orders from 77.6 to 59.6 over the same period. The figure on shipments by groups is Index A, 43.0; Index B, 41.7; Index C, 36.7. The backlog index breaks down as follows: Index A, 53.3; Index B, 76.1; Index C, 105.7.

Steel Orders Expected From Rail Price Cut

Steel makers hope to stimulate deferred buying by the railroads through a reduction in the price of standard steel rails from $43 to $40 per ton. The former figure has been in effect since 1922.

Potential buying demand has been estimated at several hundred millions of dollars. Active demand will be encouraged by the lower price.

Safety Council Elects

At the annual meeting of the National Safety Council, held in Washington, D. C., October 5, the following officers were elected:

President—J. I. Barrash, consulting engineer.

Vice-president for Engineering—J. E. Culliney, Bethlehem Steel Co.

Vice-president for Industrial Safety—George H. Warfel, Union Pacific Railroad Co.

Treasurer—Will Cooper, The Stevens Hotel Co.

Managing Director and Secretary—W. H. Cameron.

Robert L. Schmitt was selected for the general chairmanship of the executive committee of the metals section. Trophies were awarded to the Lycoming Manufacturing Co., Plant No. 1, in the machine shops division, Group A, and to the United States Rubber Co., Shoe Hardware plant, machine shops division, Group B. These cover the period January 1-June 30, 1932.

Patent List Down

As of September 30, fewer patent applications awaited action than at any time during the past five years according to Robert E. Robertson, commissioner of patents. These numbered 68,105 as against 76,732 on June 30 last, and 92,203 on June 30, 1931. A decrease of 23,157 in the number of applications awaiting action has been made by the examining divisions since the Patent Office was moved to its new quarters in the Commerce Building on January 1.

Olsen, Testing Equipment Engineer, Dies

Tinius Olsen, founder of the Tinius Olsen Testing Machine Co., Philadelphia, died October 20 at the age of 86. Mr. Olsen was a pioneer in development of a wide variety of testing machines and devices used in the metal-working and other industries. He was the oldest living member of the Franklin Institute, from which he was the recipient of the John Scott and Elliot Crisson medals.

•BUSINESS ITEMS•

On Oct. 1, the Marlin-Rockwell Corp. consolidated the sales activities formerly carried on independently by its subsidiaries: Gurney Ball Bearing Division, Standard Steel & Bearings, Inc., and Strom Bearings Co. The bearings manufactured by all of the above companies will be available through the executive and general offices of the Marlin-Rockwell Corp., 402 Chandler St., Jamestown, N. Y., at the Eastern District Sales Office, Woodford Ave., Plainville, Conn., and the Western District Sales Office, now located at 2526 S. Michigan Ave., Chicago. Branch sales offices will be maintained at their former addresses in Detroit, Cincinnati, Cleveland, Los Angeles and San Francisco. A new branch sales office has been opened at 40 W. 63rd St., New York, N. Y. The M-R-C Bearings Service Co. will continue to operate.

The Whitney Mfg. Co., Hartford, Conn., has announced that arrangements have been made with the Barbour Stockwell Co., Cambridge, Mass., to sell the complete line of Whitney silent and roller chains and sprockets in the New England territory. The Barbour Stockwell organization provides engineering service.

Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill., has appointed J. B. Whitenack as railroad representative covering all roads in the Chicago district. Mr. Whitenack was for a number of years on the railroad sales staff of Joseph T. Ryerson & Son, Inc.

Dreis & Krump Mfg. Co., 74th St. and Loomis Blvd., Chicago, Ill., has announced the appointment of the ParKett Machinery Division, Austin-

Hastings Co., Inc., Cambridge, Mass., as the exclusive distributor of its power brakes, power presses and power shears. The territory will comprise the New England States with the exception of Connecticut.

Thomson-Gibb Electric Welding Co., with plants at Lynn, Mass., and Bay City, Mich., has established a new department for the manufacture of wire mill and stranding machinery, as well as electric brazing machines. A. R. PETTERSON, formerly associated with the American Steel & Wire Co., will have charge of engineering and sales.

Several shops are provided for in the plans for a new Patterson Park Junior High School to be built in Baltimore. These shops include sheet metal, machine, woodworking, electrical, automobile repair and general shops.

The Iowa Packing Co. has finished plans for the construction of a machine shop at S. E. 18th and Maury Sts., the structure to be one story, 74x96 ft.

The Engineer's Specialty Co., 549 W. Randolph St., Chicago, Ill., has purchased the free-wheeling clutch business from the Columbia Industrial Machinery Co.

• PERSONALS •

CLAYTON R. BURT, president and general manager of the Pratt & Whitney Co., Hartford, Conn., and a member of the board of directors of the National Machine Tool Builders' Association, has been elected to membership on the board of directors of the American Standards Association, according to a recent announcement. As representative of the N.M.T.B.A. on the A.S.A. board, Mr. Burt will help shape the policies followed in the conduct of national standardization activities.

J. S. TRITLE, vice-president and general manager of the Westinghouse Electric & Mfg. Co., was elected president of the National Electrical Manufacturers' Association to succeed John H. Trumbull of Connecticut.

A. M. BARRETT, prominent for years in the materials handling industry, has again assumed control of the Barrett-Cravens Co., which will move into its own three story plant at 3255 W. 30th St., Chicago.

SAM T. JOHNSTON, for many years vice-president of the S. Obermayer Co., Chicago manufacturer of foundry supplies, retired recently. Mr. Johnston will continue as president of the Standard Sand & Machine Co., Chicago. He is a charter member of the American Foundrymen's Association.

JAMES R. SHELDON has been elected president of the Beardsley, Wolcott Mfg. Co., Waterbury, Conn., to succeed R. W. REID, resigned. Mr. Sheldon was formerly vice-president and general manager. He was elected president of the Waterbury Clock Co. recently under the reorganization.

• OBITUARIES •

HANS LUTHI, superintendent of plants for the Nash Motors Co., Kenosha, Wis., died October 11. He became connected with the Thomas B. Jeffery plant at Kenosha in 1906, and remained when it was absorbed by the Nash Motor Co.

WILLIAM BOOTH GAMMONS, president of The Gammons-Holman Co., Manchester, Conn., died October 2. Mr. Gammons invented the helical taper pin reamer bearing his name, a chucking reamer and the "Parob" reamer. He also perfected the intermittent alarm clock and the automatic money changing machine.

EUGENE I. BLOUNT, 78, who retired about a year ago from the treasurership of the J. G. Blount Co., died October 17. Mr. Blount, together with his brother, J. G. Blount, founded the J. G. Blount Co. in Everett 30 years ago for the purpose of manufacturing machinists' tools.

SAMUEL AMDURSKY, consulting engineer and head of the mechanical department of the Taylor Instrument Companies, Rochester, N. Y., died Oct. 6, at the age of 40.

JOHN A. ENGLE, superintendent of the metal and wood pattern departments of the J. I. Case Co., Racine, Wis., died recently.

H. J. FLOREY, vice-president and general manager, C. B. Porter & Co., Philadelphia, metal fabricator, died Oct. 9.

JOHN RIPLEY FREEMAN, president of the American Society of Mechanical Engineers in 1905, and a prominent consulting engineer, died Oct. 6, aged 77.

CLARENCE F. FOWLER, manager of the branch sales office of the Independent Pneumatic Tool Co., in Toronto, Ontario, for a number of years, was mortally wounded while hunting and died October 15.

WILLIAM E. GANG, retired manufacturer of machine tools, died October 16 at the age of 77. After being general manager of the Lodge & Davis Co., Mr. Gang became a member of Dietz & Gang, and subsequently organized the W. E. Gang Co.

GEORGE M. GRISWOLD, 84, died October 12. He was an organizer and president of the George M. Griswold Machine Co., and to his credit are placed inventions of paper-box machinery and subpress dies for clock and watch work.

H. W. HAYWARD, professor of materials engineering, Massachusetts Institute of Technology, died Oct. 18. He was considered to be one of the country's leading authorities on engineering materials and had been full professor since 1920.

LEO MELANOWSKI, once a famous consulting engineer, and at one time chief engineer and technical director for ALEXANDER WINTON, automobile builder, died in a charitable institution October 12.

JOHN A. OBERHELMAN, founder of the J. A. Oberhelman Foundry Co. and a vice-president of the King Machine Tool Co., died recently at the age of 70.

GEORGE F. ROOT, president and treasurer of Root, Neal & Co., machinery dealer, Buffalo, died Oct. 6. Age, 61.

CHARLES SHARTLE, a founder of the Shartle Bros. Machine Co., manufacturers of paper machinery at Middletown, O., died recently at the age of 70.

C. A. W. VOLLRATH, president of the Vollrath Co., Sheboygan, Wis., manufacturer of enameled steel and cast iron wares, died recently.

FRED G. WALKER, 64, supervising engineer and director of the National Screw & Mfg. Co., Cleveland, died Oct. 6.

FREDERICK YUNKER, 66, foreman of the Des Moines, Ia., city railway machine shops for more than 15 years, until his retirement, died suddenly October 5.

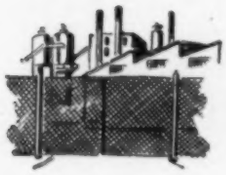
• MEETINGS •

NATIONAL FOUNDERS ASSOCIATION. Thirty-sixth annual meeting, Waldorf-Astoria Hotel, New York, November 16-17. J. M. TAYLOR, secretary, 29 South La Salle St., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual meeting, New York, December 5-10. Calvin W. Rice, secretary, 29 West 39th St., New York, N. Y.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. December 5-10. Grand Central Palace, New York.

THE ROUND TABLE



Branching Out

"Howdy, Ed. How's everything at the factory? I haven't seen anyone from there for a couple of weeks."

"Everything is going just fine. We are getting some repair work and a few orders for spare parts. Looks as though one or two people were thinking about starting up some of their idle machinery. How're things with you, Al?"

"Good as can be expected, we're thinking of putting on some help."

"Congratulations, Al. I'm glad your compressor business is increasing enough to put on men."

"Oh, the man won't be for compressor work. That is, not primarily. We're going to increase our line."

"What can you manufacture with rotary compressors? I can't think of a thing, unless it's a reciprocating compressor to substitute when a rotary won't work."

"We're going to add a line of valves. A lot of small shops around the country have gone into the valve business lately. They take some particular type and size, improve it or cheapen its cost and market it. It's helped quite a few shops over the bumps."

"Well, aside from the bumps, what has your shop got in common with the average small shop? Yours is an engineering shop; theirs are job shops."

"But Mason has designed a dandy little air valve, and the only jobber we have shown it to will sell 2,000 a year for us."

"At how much net profit?"

"About twenty-five cents each."

"Is that worth neglecting your compressor business for?"

"We won't have to neglect it. We use the tools we have, and make a quick turnover of capital. We figured the man's labor as continuous, but as a matter of fact, he'll have time to do a lot of work on compressor parts. That will leave me free for engineering and service work, and Mason will have more time for sales."

"That sounds all right, but it won't work out that way. You'll find that the little stuff will take up lots of your time and the compressor engineering and sales will be neglected. On the other hand, if you get an order for a compressor, you'll start the man on it, and won't like to break down the job until it's finished. Then you'll be late on valves and will have to work overtime on them. Leave well enough alone. Stick to one thing."

"Every firm that can, Ed, is adding to its lines. They realize that it's foolish to depend upon a single article; the demand fluctuates too much. We expect to push the sale of rotaries for air compressor work, and a good air valve that will not leak is right in our line—so is an ammonia valve."

"That isn't what I'm arguing about. I'm saying that you and Mason can't give proper attention to more than one thing. You'll find that the firms that are adding to their lines, are adding engineers to their staffs, too. If you can make and sell a good air valve go to it, but get a man who can do the designing and selling."

"There isn't enough profit in it for that Ed, at least not now. It would take $50,000 a year to justify another man."

"Well, are you going along at $2,000 and be satisfied? If not, who's going to sell them? You?"

"No, Mason would probably do that."

"Thousand-dollar compressors and one-dollar valves. Automobiles and spark plugs. We would never have heard of the man who built wonderful mousetraps in the forest, if he had tried to make the bait for them, too."

Will adding a line of valves be too great a tax on the time and capacity of the partners?

Discussion

Books and Bosses

A baseball game, or any other competitive sport, cannot be enjoyed to its fullest either by participants or spectators unless the score is known at all times during the contest. The same rule holds true in business—the score must be kept accurately. No business, whether large or small, newly organized or old established, can operate successfully without an accurate accounting of costs and results.

We can well call the manufacturer the participating player in the game and his creditors interested spectators. If the manufacturer doesn't deem it necessary to keep score, he can rest assured that his creditors do.

If the manufacturer cannot sell his product at a price that will enable him to incorporate the costing expense in the total cost of his product, he will be better off if he abandons his activities and ventures his time and money in some other business or product.

If we assume that the newly organized company cannot afford an adequate accounting organization, we are just as safe in assuming that the same company does not have sufficient funds to expand when sales warrant such expansion. In order to expand, money would have to be borrowed, and unfortunately, loans are not secured on the strength of advance orders or anticipated sales increase, but on bona fide proof of past profits and the reliability of the individuals involved. And how can any company or its officers be considered

reliable or a good financial risk if they don't maintain a set of books and a record of manufacturing costs?

Keeping a set of books will show Al and Mason whether they are making a suitable profit when their product is sold at a price which is in line with their competitors' prices. However, a set of books will not show them how to lower their manufacturing costs. A historical record of unit costs and vigilant supervision over these costs must be maintained. An incessant war must be waged against these costs, using for weapons better methods, better equipment and a scientific deployment of management on all fronts.

There is no place today for empirical methods in shop and office. There is one best way to play the game, and to play the game this best way the score must be kept. —Ira S. William.

Slightly Worn

Before spending their precious capital in either machine, the partners should ask themselves the following questions:

1. What will the fixed charges be in each case, considering depreciation, interest on investment?
2. What operating economies, if any, does the new machine offer?
3. Will the new machine turn out a more accurate product, meaning better performance, and more sales?
4. How much of their limited capital can they afford to tie up?
5. Will design changes make the machine obsolete?

Questions 1 and 2 can be answered by estimated figures. For example:

	Second Hand	New Machine
Cost	$2,000.00	$8,000.00
Estimated life	1½ yrs.	6 yrs.
Production per year	50 units	50 units
Fixed charges per year (including interest)	$1,787.00	$1,813.00
Fixed charges per unit	$35.74	$36.26

Under question two, the new machine should at least save in repairs and tool costs, even if it does not actually work faster. For instance:

	Second Hand	New Machine
Repairs per year	$200.00	$50.00
Tool cost per year	100.00	75.00
Total	$300.00	$125.00
Production per year	50 units	50 units
Total per unit	$6.00	$2.50

These examples show an advantage in favor of the new machine but under other conditions the reverse might be true. If the answer to Question 3 is yes, sales will increase, they should estimate the increased profit, apply it against the fixed charges and thus correct the answer of question one for the new conditions.

Having all these answers the partners can judge whether there is any economic benefit in the new machine. If there is none the problem is solved. If there is an advantage they should settle Question 4. The extent to which they should be willing to tie up their capital will depend on the extent of the economic advantage of the new machine. In determining this answer the partners should estimate the amount of cash they need to carry on the business. The remainder of their capital can be put into fixed and current assets.

Now comes a question, No. 5, that cannot be settled mathematically. Since the partners are just starting to manufacture a new product, radical design changes might be made in the near future. There is the possibility that then the machine will not be needed at all, or that outsiders could then do the work without any trouble and more cheaply. It would be better for the partners to lose some profit than to hamper changes in design.

—Bernard Shereff,
Engineer, Standards Department,
American Hard Rubber Company.

Ed is against the purchase of a used boring mill because he could not determine any way of testing its bearings. We are in the used machinery business, and the test would not be necessary as recognized used machinery dealers today all have facilities for rebuilding heavy and light equipment. In our case boring mills or any other machines are literally torn down and rebuilt from the ground up.

In addition to the satisfaction of receiving a machine which is guaranteed to serve almost the lifetime of a new machine and give entire satisfaction during its operation, there is a considerable saving involved, especially in the case of certain machines, like boring mills, where the price of a new machine is usually two and one-half to four times greater than the price of a used machine. A used machine also serves as a good investment for a job that does not warrant purchase of a new machine as it would pay for itself in a much shorter time. —Joseph H. Donberg,
Louis E. Emerman & Company.

Shall the Customer Furnish Gages?

The small shop proprietor who expects the customer to furnish gages with each set of blueprints and is foolish enough to insist on it, is going to find his orders dwindling. Indeed, from my own experience, he is fortunate in having clear-cut tolerances to work too, as the small shop man is more often called upon to exercise a high degree of judgment in this matter when the awarding of a contract depends upon the accurate machining of the first small lot.

I would hold Tucker directly responsible for the misalignment of the parts under discussion, as they should have been inspected before leaving his shop in a more thorough manner; in a case similar to this, I know of one jobbing shop owner who voluntarily reimbursed his customer for the delay and financial loss attendant on such a mistake, thus retaining the customer's goodwill and his own reputation for square dealing.

From the angle of the large scale manufacturer, the same policy of machining parts on a contract basis to the customer's specifications, without requiring him to furnish gages, seems to be a general custom with few exceptions. Which would incline me to the belief that accepted instead of evaded responsibility pays. —Robert S. Alexander.

In these days of accurate master blocks there is no need for the customer to supply gages with his order. If the blue prints give the dimensions and the tolerance then it is up to the machine shop to do the job.

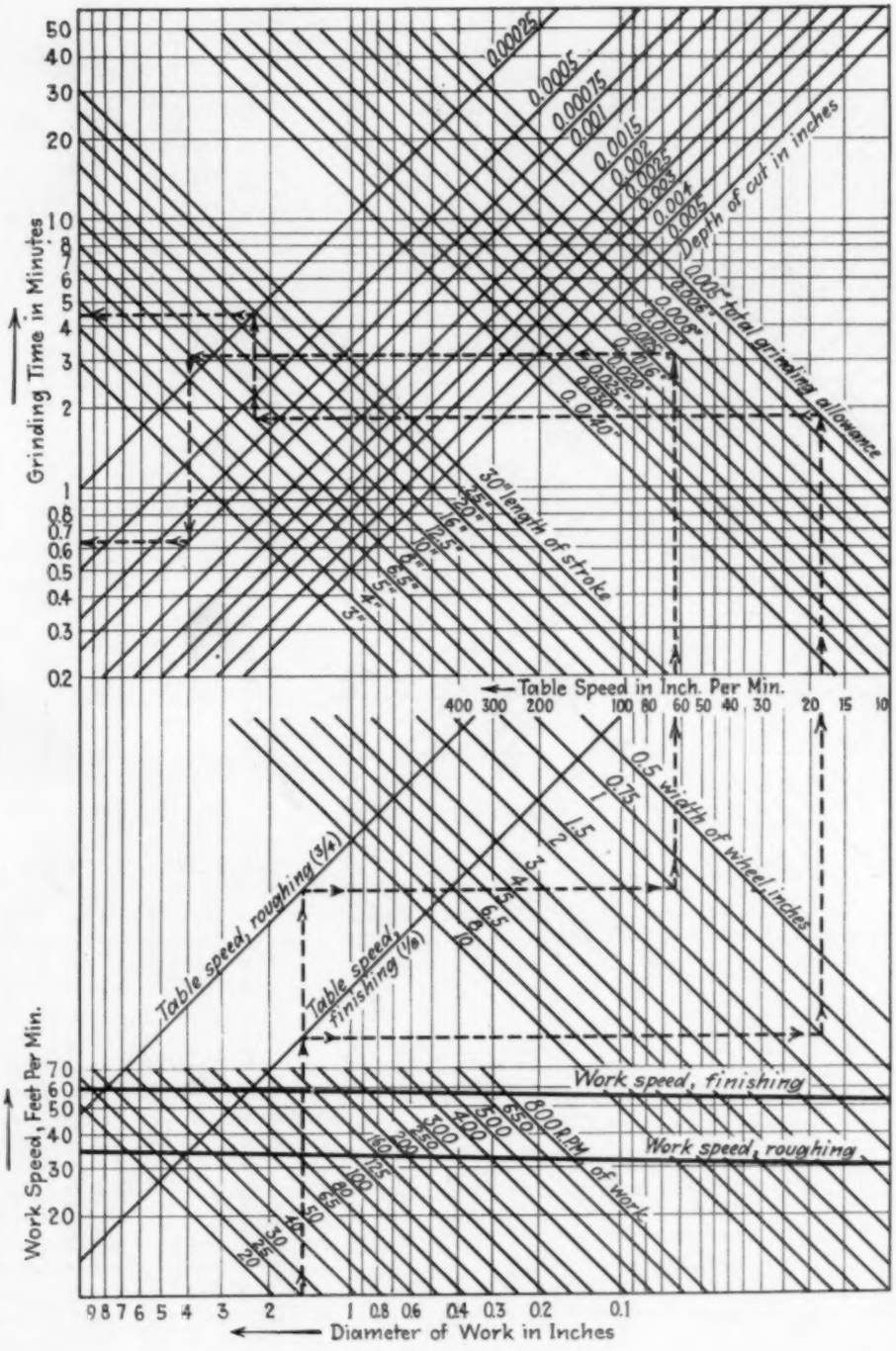
On a large order the machine shop will frequently make gages for its own convenience and ultimate economy but that has nothing to do with the customer. If, however, on some standard production pieces the customer has a set of gages, which he proposes to turn over to the machine shop for their convenience, then he should obtain a closer quotation.

My own experience has been that it is unsatisfactory to supply gages because if some unprincipled party juggles the gage to fit pieces which are "slightly off" then you have a job on your hands to prove that the gage ever was right. But there can be no argument about a plus and minus dimension, and it can be positively checked by accurate micrometers. On intricate pieces where we have had special gages it has been our method to state in a letter that we would be glad to loan the gages but the machine shop would have to standardize them and we would check by dimensions given on blue prints only.

—George P. Pearce.

American Machinist
Reference Book Sheet

Chart for Cylindrical Grinding Time



THIS chart is laid out for hardened steel, for which an economical work speed of 30-35 ft. per min. is best for roughing and 50-60 ft. per min. for finishing. Similar charts for soft steel and cast iron can be made by resetting lines "Work Speed—Roughing" and "Work Speed—Finishing." Both lines are slightly inclined because with increase in work diameter a slightly higher work speed should be used (Norton: *Grinding Wheels, Machines, Methods*). Lines marked "Table Speed—Roughing" and "Table Speed—Finishing" are laid out for a table feed of ¾ wheel width for roughing and ⅛ for finishing.

Example: Hardened steel pin: 1.5 in. in diameter; 6 in. long; grinding allowance, 0.015 in.; stock removal, 0.010 in. for roughing, 0.005 in. for finishing; feeds-roughing, 0.001 in.; finishing, 0.00025 in.

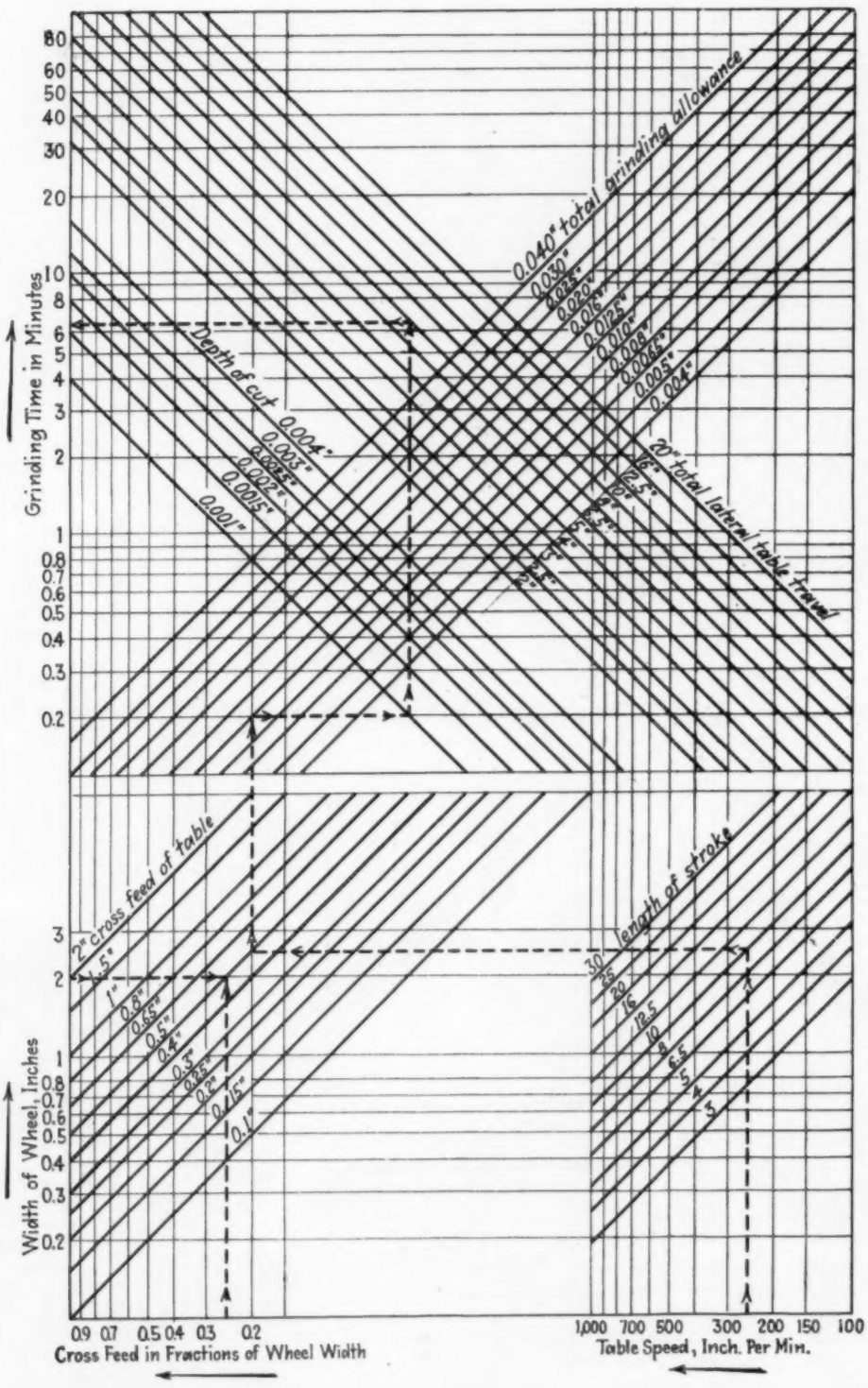
On the lower half of the chart find the work diameter and follow the dash line to "Work Speed—Roughing" and "Work Speed—Finishing." Values are 85 and 145 r.p.m. The dash line divides at "Table Speed—Roughing" and "Table Speed—Finishing" because of the different table feeds. Values are 63 and 18 ft. per min. Going to the upper half of the chart and taking into account the different wheel feeds for roughing and finishing and selecting a table travel of 8 in., it will be found that roughing time is 0.64 min. and finishing time is 4.4 min., not including setting up or handling.

Contributed by H. Kaffine

© American Machinist

American Machinist
Reference Book Sheet

Chart for Surface Grinding Time



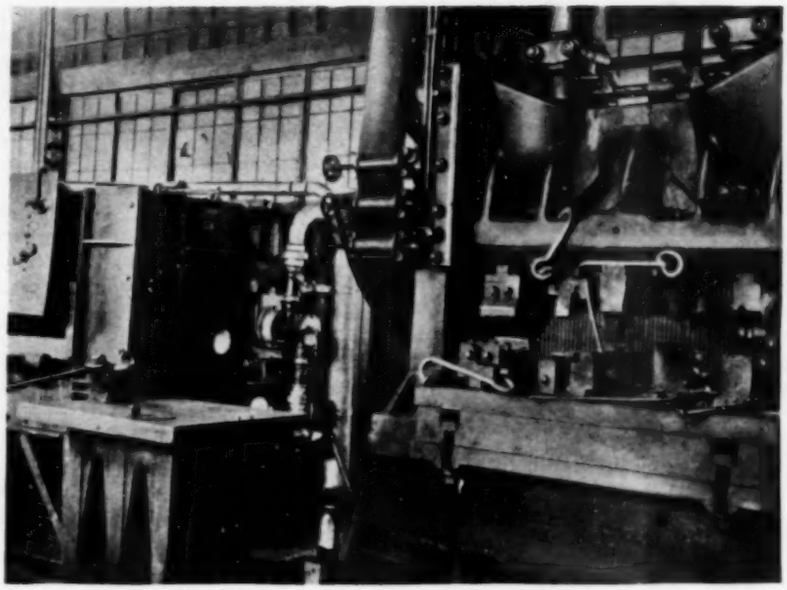
MANY surface grinders have but one table speed, but with others it will be necessary to select the proper table speed for a given condition. Selection of the proper cross feed at each table reversal depends upon the width of the wheel, whether dry or wet grinding is used, and also upon the nature of the work. Total lateral table travel is the sum of the width of the work plus an amount dependent upon the width of the wheel to allow the latter to clear the work. The same applies to the length of the stroke.

Example: A plate, 8 in. long and 5½ in. wide, is to be ground, total grinding allowance being 0.010 in. The machine has a table speed of 250 in. per min., and the width of wheel is 2 in. Allow a moderate cross feed of ¼ of the wheel width, that is 0.5 in., set the length of stroke at 10 in. so that the wheel clears the work, and set the total lateral table travel at 8 in. for the same reason and have the wheel take a cut of 0.001 in. per pass. By following the broken line and the arrows on the chart it will be found that the net grinding time for this example is 6.4 min.

Contributed by H. Kaffine

© American Machinist

• IDEAS FROM PRACTICAL MEN



Press Bending a "Pigtail"

W. J. TANGERMAN
Shop Superintendent, Union Metal Products Co.

"Pigtails"—any bend in a bar that is a full turn or more—have always been made by hand, accompanied by much battering and reshaping by the blacksmith. A new product necessitated that we form such a pigtail at the end of a ¾-in. bar, and in quantity. The set of dies illustrated was devised for the work. As positioned in the press they are numbered 1, 2, 3, 5, 4 from right to left. The sequence of operations is indicated in Fig. 2. The bar is headed in a forging machine, then brought to the press for pigtailing.

The first operation forms a U at a slight offset from the axis of the bar, the second brings the U around to form a hook, and the third completes the pigtail as indicated. The fourth operation forms a "J" hook on the opposite end, and the fifth flattens the body of the J. Occasionally, on certain jobs, the hand bender shown on the bench at left in Fig. 1, is used to increase the "kink" at the beginning of the pigtail.

The dies are set up in a crank press. Their design is evident from the illustration, and offers no trouble once the principle is worked out.

It will be noticed from the partially formed pigtails in the dies that the bar is fed vertically for the third and fourth operations. This was inconvenient until the tongs illustrated in Fig. 3 were developed. The bar is held in the side grips for the first two operations. When bumped against a die block as the tong grip is loosened, the bar snaps forward into the other grip for the next two operations, then is pumped back for the last one.

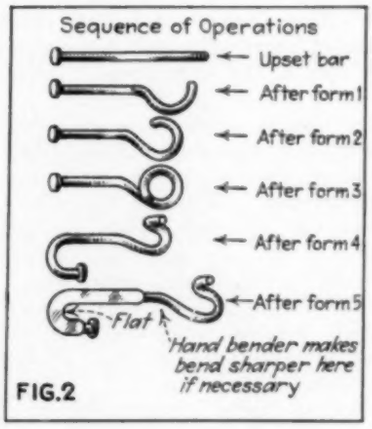


FIG.2

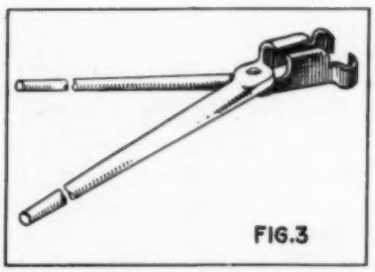


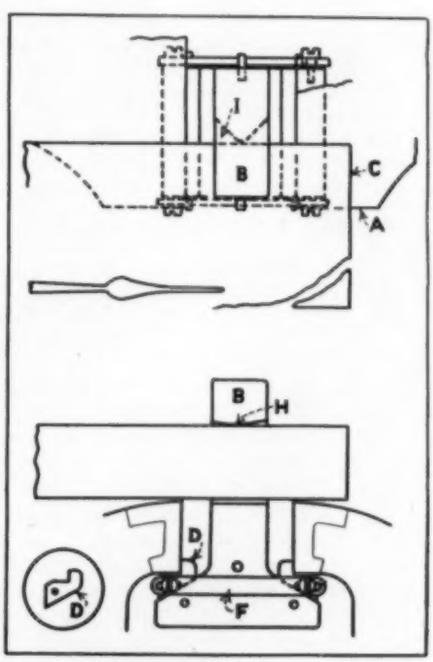
FIG.3

Diemakers' Utility Vise Fixture

WALTER WELLS

For holding die-blocks when filing intricate or narrow blank outlines, or odd-shaped piercing holes, the use of the fixture illustrated eliminates the necessity of swiveling the entire vise or of using an intermediary parallel clamp. The option of clamping the die-block by just one corner affords a generous overhang in relation to the vise and, by the same token, gives comfortable hand clearance. Provision is also made for swiveling the block to any necessary angle. Beside these primary functions, the fixture will be found useful when laying out, scribing, prick-punching, light tapping, setting toolmakers' buttons, and checking dimensions on all sorts of dies, for reasons obvious to any diemaker.

Referring to the illustration, *A* is the vise; *B* the fixture, and *C* is a die-block clamped "outboard." Notched slides *D*, fashioned from ⅛-in. ground stock, and held in approximate position by the links *F*, which have elongated holes to permit the slides a certain amount of



movement, are used to actuate the clamping device. The fixture is shaped as shown, its clamping arm being rounded off to give a one-line contact, as at *H*. The throat *I* is relieved at an angle of 45 deg. on each side to permit swiveling without loss of clamping effectiveness. The seats for the slides are at an angle of 30 deg., thus permitting the slides sufficient vertical movement to accommodate variations in die thickness and yet transmit the full normal pressure of the vise jaws. Six pins, one above and two below each link, confine the vertical movement of the fixture to ⅛ in. The proportions of the fixture are such that the dimension of the die may vary from $\frac{15}{16}$ to $1\frac{1}{16}$ in. in thickness.

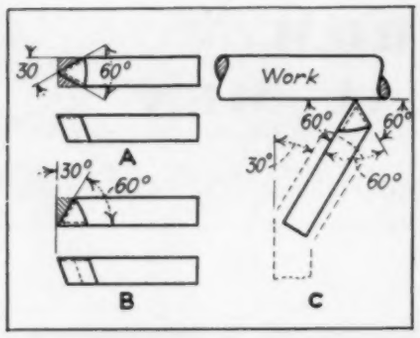
In use, the fixture, together with the die, is steadied in the vise with its jaws opened about 1½ in. In closing the vise jaws they will engage the slides and wedge them obliquely to give the fixture the downward clamping action. Equalization of pressure takes place automatically. Incidentally, there is no great strain on the vise screw, as when directly clamping pieces having a marked overhang. Also, when the die is intermittently removed for inspection, the fixture may be stood up on a suitable block of wood placed on the vise slide.

As it is, the fixture is designed with the view to the most rapid working consistent with its purpose and utility. If so desired, divers refinements, such as an equalizer on the slides, as well as dovetailed guides for the slides, may be added. It may be especially desirable to have the fixture fit vises of various makes, in which case the clamping arm can be made higher to allow for inset pieces. However, there is no need to go to extremes in the design, as a good man will get adequate use out of the fixture as it is by adept handling. Pack-hardening of all parts of the fixture is recommended.

Saving High-Speed Steel

EDWARD LAY

The customary way of grinding toolbits for cutting threads is shown at *A* in the accompanying sketch. If the toolbit is ⅜ in. square, the area ground away, as indicated by the shaded section, is approximately 0.0609 sq.in. If the tool bit is ground as at *B*, the area ground away is approximately 0.0406 sq.in., or about two-thirds of that at *A*. Therefore, there will be a saving of one third of the steel. Although the saving in steel may not amount to much in dollars and cents, if the toolbit is tipped with Carboloy or any of the expensive



alloys, the saving will be quite appreciable.

A toolbit ground as at *B* and held in a straight toolholder, the holder must be set at an angle of 30 deg. to the cross slide, or 60 deg. to the work. If a toolholder having an offset of 30 deg. is used, as at *C*, its shank can be set parallel with the cross slide or at a right angle to the work.

Saving Time in Planer Work
Discussion

FRANK C. HUDSON

The proposal of J. C. Harper (*AM*—Vol. 76, page 1008) is much more practicable in every way than that of D. Q. Dunstone. The use of additional planer tables as originally proposed involves not only the use of valuable space as Mr. Harper points out, but the difficult task of securing perfect bearing ways on each of the extra tables.

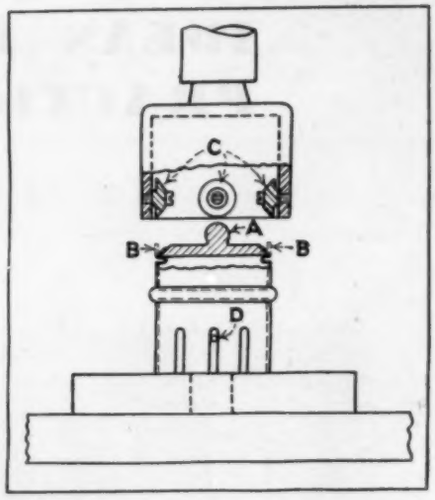
It is bad enough to maintain a perfect bearing where only one table is used. The lifting of additional tables, with the work in place, would be almost sure to cause deflection in the tables and result in inaccurate work. Auxiliary tables, with the work set up by a special man is a much better plan. It seems possible, however, that inspection before removal from the table might fail to detect changes due to faulty clamping.

As Mr. Harper says, the idle time of the machine is more important than that of the man.

Tool for Rolling a Bezel

WALTER SIMPSON

The tool illustrated was used in a lamp factory for rolling a bezel to hold the glass ornament *A*. The material is $\frac{1}{32}$-in. sheet brass and the dotted lines *B* show the shape at the top of the work before the rolling operation. At first we tried spinning the bezel in the lathe, but many of the glass ornaments were broken by the pressure required in spinning. After many experiments, we decided to roll the bezels on to the ornaments, so we made the tool illustrated and did the work in the drill press.



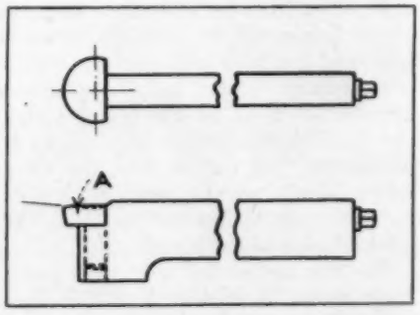
The tool has four angular rollers *C* that revolve when in contact with the work. By feeding the tool to the work in the usual way, the operator could tell by the sense of feeling when the bezel was rolled tightly on to the glass. The work was mounted on a stud attached to a plate, the pin *D* engaging one of the slots to prevent it from revolving.

Easily-Made Radius Tools for O. K. Holders

PETER L. BUDWITZ

The job of making radius tools is greatly simplified by having them made to fit standard O. K. toolholders. The general practice usually followed is to file or grind a piece of steel to a templet or a radius gage. This method is slow and tedious if an accurate and satisfactory job is desired.

Radius tools similar to the one at *A* in the illustration are readily turned in the lathe and flatted to fit the holders. The top rake the front clearance can be machined in the turning operation. After the turning has been completed, a section of the large diameter is milled off to form a flat spot to be used in locking



the tool to the holder, as is characteristic in all O. K. tools. The shank of the tool is, of course, turned to fit the hole in the holder.

Fixture for Holding Gears

A. OUTWATER
Supt., R. N. Brodie Company

It became necessary a short time ago to ream 0.010 in. out of the 0.427-in. holes of a lot of small gears of phosphor bronze. At first, the job seemed simple enough, but when we tried it we found that the reamer bound so tightly that the gears could not be held by hand. As the teeth were already cut, we had to be careful not to injure them.

We tried several ways of holding the gears, but had no success until we made the fixture illustrated. One of the gears was cut in half and one of the halves was tightly riveted to a piece of flat, cold-rolled steel, as at *A*. The other half *B* of the gear was pivoted to the same piece of cold-rolled steel at *C*. The gear to be reamed was placed between the two halves and in mesh with the half *A*. When the half *B* was swung into mesh with the gear to be reamed, it acted as a pawl to prevent the gear from turning. The strip of steel *D* kept the gear from cocking while reaming.

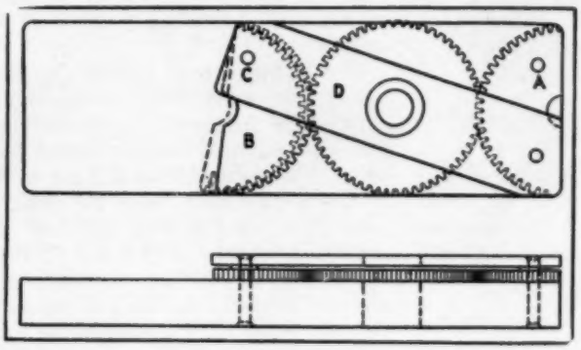
Press Tools for Flat Springs

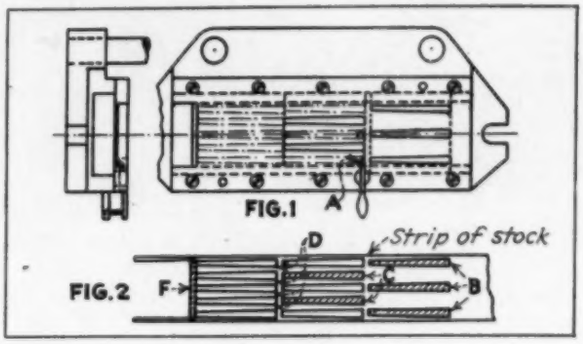
ANDREW BEUSCH

Having to make large quantities of flat springs from $\frac{1}{16}$-in. tool steel, we made the press tools illustrated in Fig. 1. The springs are 4½ in. long and are tapered, being $\frac{1}{4}$ in. wide at one end and $\frac{1}{8}$ in. at the other.

In operation, the strip stock is fed from the right until the end contacts with the stop pin *A*. At the first stroke of the press, the three springs *B*, Fig. 2, are blanked. As the stock is fed farther, the right-hand end of the lower opening contacts with the stop pin and two round pilots (not shown) in the punch locate the strip accurately by the center opening, as indicated by the small circles at each end of the opening in Fig. 1. With the strip in this position, the two springs *C*, Fig. 2, are blanked at the second stroke. This second operation leaves the four springs *D* still attached to the strip.

When the strip is advanced another stage, being again located by the stop pin and the pilots mentioned above, the third stroke cuts off the scrap piece *F* at the ends of the four springs *D*. At the next advance of the strip, the four springs *D* are cut off. It will thus be seen that after these four springs have been cut from the strip, nine springs are produced at each stroke of the press. By the use of these tools more than 90 per cent of the stock is utilized.

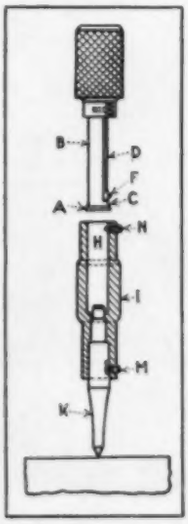




A Semi-Automatic Center Punch

GEORGE J. MURDOCK
Murdock Research Laboratory

The ordinary automatic center punch is not only expensive, but is so difficult to make that its production is seldom attempted by any but the larger tool manufacturers. Also, it has the disadvantage of requiring so much pressure to compress the spring that unless it is held accurately vertical, it is likely to slip.



The punch herewith illustrated is not only simple in construction and free from the disadvantages mentioned above but is easy to make by anyone having a lathe. Referring to the illustration, the lower end *A* of the plunger *B* is about 0.002 in. larger in diameter than the part *B*. At *C*, the lower part of the plunger is flattened, while the same side is flattened for the rest of its length to a greater depth to give working clearance to the flat spring *D*, which is secured at its upper end by a screw. At its lower end, at *F*, it is bent to form a V-shaped point.

The lower part of the plunger is an easy sliding fit in the bore *H* of the holder *I*, and when it is at its lowest position in the bore, the end *A* contacts with the top of the punch *K*, which slides in a smaller bore in the holder, its motion being limited by the point of the screw *M* engaging in a short slot.

For clearness, the plunger is shown out of the holder. In assembling the device for use, the screw *N* is slackened and the plunger is inserted in the holder, after which the screw *N* is driven in until it makes sliding contact with the flat *C*, which now prevents the plunger from turning in the holder, and contact of the V-point of the flat spring with the screw *N* prevents it from descending farther into the holder until downward pressure is applied. When the holder is held between the second and third fingers of the right hand and the top of the plunger is pushed down by the first finger, the pressure required to cause the V-point of the flat spring to pass by the screw *N* makes the plunger descend at high speed and strike a heavy blow on the punch.

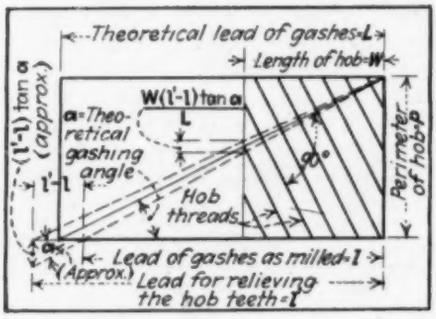
The force of this blow can be be regulated by the distance the screw *N* is turned in. Ordinarily, the punch is moved along the layout line by the left hand, while the plunger is manipulated by the first finger of the right hand. The pressure of the punch against the work is such as is given by the left hand only, therefore slipping is avoided. Both in its descent and in resetting for the next blow, the plunger is prevented from turning in the holder by the contact of the end of the screw *N* on the flat spring. Work may be laid out as quickly as with the full-automatic punch. The entire unit is self-contained and easy to use.

Gashing and Relieving Hobs

FRANCIS W. SHAW

Tool and Gear Consultant
Heywood, Lancashire, England

Hobs, particularly if they are multi-threaded, are customarily gashed at right angles to their threads. The gashing angle is, therefore, complementary to the thread angle. Whatever the gashing angle may be, it is seldom possible by the gears provided, either on the universal milling machine or on the relieving lathe, to reproduce the theoretical lead angle, consequently, approximations have to be accepted. If the approximations are alike for both operations, they can depart from the theoretical figure quite appreciably without affecting the functioning of the hob.



Unfortunately, it is not always possible to get the approximations alike and the problem arises as to how much the difference may be without causing trouble in the relieving process. From the accompanying diagram, in which a is the theoretical gashing angle corresponding to the theoretical lead L, it will be clear that if the gashes have been milled to a different lead, say as l, and the change gears used on the relieving lathe would cause the relieving to follow other (imaginary) gashes having the lead l', in a complete lead length the form tool would be either leading or lagging by the amount approximately equal to $(l'—l)$ tan a, and in the hob's length by this quantity multiplied by the hob length W and divided by the lead L.

The usual method of overcoming this difficulty is to set over the tailstock so that as the carriage travels along the lathe bed, the time at which the form tool, in its relieving stroke, makes first contact with the hob is either retarded or accelerated, according to the direction of the error. While in theory, the result is not absolutely accurate, it is good enough. But this procedure entails certain trial settings for the taper, which are well worth avoiding. And generally they can be avoided if attention be given to the approximations adopted.

It is perfectly obvious that if the constant gears in both machines were of like ratio, the change gears for both operations could be alike, or at least of like ratio. But usually the constant gears are not of like ratio. In the universal milling machine, the ratio is usually 10, whereas in most relieving lathes it is 16. For the milling machine, the change gear formula is:

$$\frac{\text{Lead}}{10} = \frac{\text{Driven Gears}}{\text{Driver Gears}} = r$$

and for the lathe it is usually:

$$\frac{\text{Lead}}{16} = \frac{\text{Driven Gears}}{\text{Driver Gears}} = R$$

If, then, the train used for the gashing operation be known, a suitable train for the relieving lathe could be found by the following formula, which is derived by combining the formulas given above:

$$\frac{\text{Driven Gears}}{\text{Driver Gears}} = \frac{10r}{16}$$

in which r can be replaced by the actual numbers of teeth in the milling-machine gear train. While the numbers of teeth in the lathe set may not coincide with those in the milling machine set, it is frequently possible to find an alternative exact set. Where this is not possible, and with the provided gears a good-enough approximation can not be found, a slight change in the lead may have the desired effect.

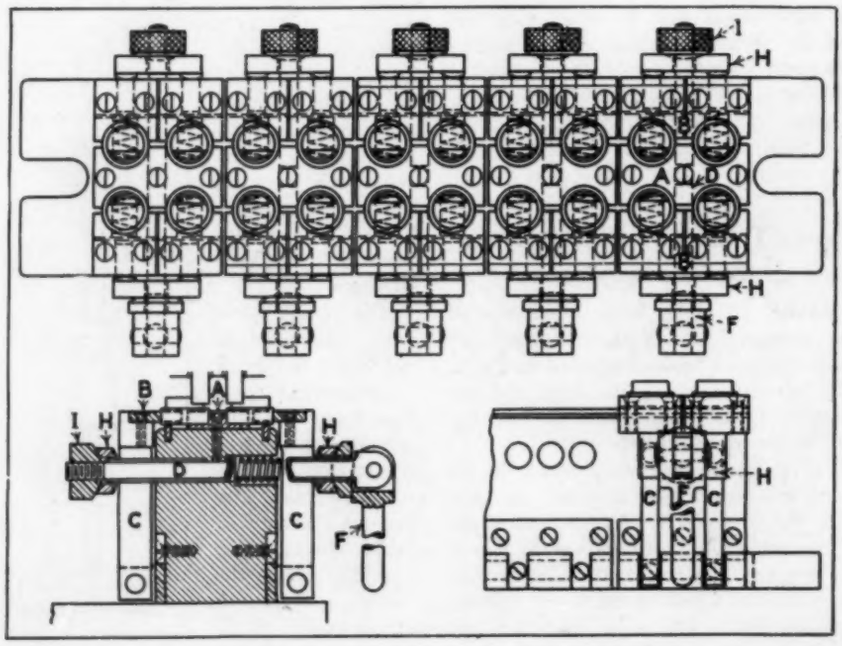
Since the majority of universal milling machines employ like gear trains for like helical leads, it is a pity that provision is not made in relieving lathes to use the same trains. Trouble would be avoided if the tool designer would investigate the matter before setting down the leads on his drawing, taking care that the lead could be obtained exactly on both machines. Preferably, having had the trouble of ascertaining the proper trains, he should insert the information on the drawing.

A Quick-Acting Equalizing Fixture

EUGENE L. SOLTNER

We had an order for a very large quantity of steel cups that were to be cut away on one side for part of their depth, leaving a D-shaped opening when viewed from the top. The cups were machined from a solid bar in the screw machine, the sides being cut away by milling.

Two milling fixtures like the one illustrated were made, each holding twenty cups. The fixtures were divided into five sections, each section holding four cups. The stationary jaws A are in the center of the fixture, while the movable jaws B are at the front and rear and are attached to the pivoted legs C. Bolts D run crosswise through the fixture and are used to clamp the work by means of the cam levers F. Pressure on the work is equalized by the floating pads H at each end of the bolts. The bolts are threaded at the rear ends and are fitted with the knurled nuts I. The speeds and feeds were adjusted so that an operator could load one machine while the other was at work. Production was 850 pieces per hour.



Ford Scraps One Junk Per Minute

A GIANT hydraulic baling press, which in a single stroke converts a "retired" automobile into a compressed bundle of scrap metal hardly larger than a bale of hay is now in operation at the Rouge Plant of the Ford Motor Company. Installation of the press, two 600-ton hot metal mixers and a new 400-ton furnace for the conversion of scrap metal, in addition to necessary supplemental equipment, cost approximately $500,000 and increased the melting facilities of the plant open-hearth furnace equipment by 600 tons daily, bringing the total capacity to 2,600 tons every 24 hours.

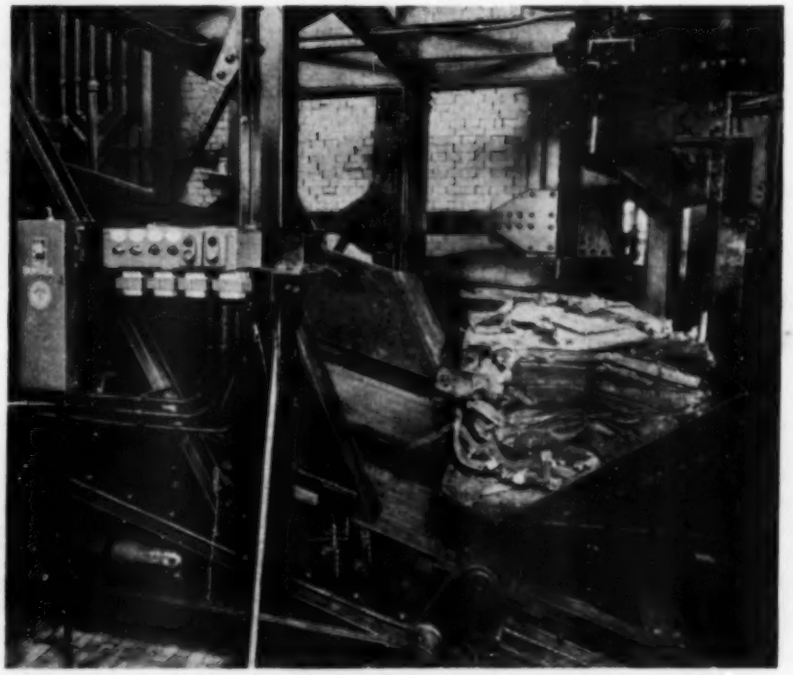
Addition of these facilities was part of a program of expanding the capacity of the plant's salvage department and of increasing the supply of scrap. The company thus far has disassembled more than 72,623 "worn out" cars, and the steel and other materials in them which were capable of salvage have been returned to productive use.

Old automobiles, purchased by company dealers in the Dearborn, Mich., territory, are delivered to the Rouge Plant where they are wrecked. All materials of salvage value, such as glass, leather, tires, batteries, radiators and some other non-metallic products are removed. In the days before the giant baling press and the huge furnace were installed, the cars were crushed and the wreckage sliced to sizes suitable for admission to the furnace where it was mixed with molten pig iron and refined into steel.

Under the new arrangement it only is necessary to run the stripped cars into the powerful hydraulic press which shapes them into compact bales at the rate of approximately one per minute.

A conveyor deposits the bales in charging boxes and the boxes are emptied into the new furnace. Following the melting process the scrap steel is transferred by crane-swung ladles to any of nine 100-ton open hearth furnaces adjacent to it.

Junked, stripped car under baling press which exerts 1,000-ton pressure. Resultant bale is 6 ft. long, 30 in. wide and 18 in. deep



Bale being dumped from conveyor to charging box at furnace

SHOP EQUIPMENT NEWS

Gridley Model R Four-Spindle Automatic

Collet capacity of ⅞ in., high spindle speeds for small diameter work and a fast, shockless indexing mechanism are found in the Model R Gridley automatic announced by The National Acme Co., 170 E. 131st St., Cleveland, Ohio. The machine is basically designed for the high-speed modern cutting tools. Frame and pan are of box form with a heavy top section to tie the gear section to the spindle frame. The gearbox section is also a rigid box form casting with a heavy internal cross wall to eliminate vibration at high speeds.

The "Acme-Graybar Chronolog" (*AM*—Vol. 76, page 1045) is furnished with the Model R, although not shown. Briefly, the Chronolog records the number of pieces produced and the active and idle time of the machine. It furnishes means to insure maximum net production after the demonstrator has left the customer's plant.

Width of the spindle carrier bearings has been increased and likewise the overall length of the carrier, affording better support under heavy forming cuts. Length of the spindles, collet and feed tubes has been correspondingly increased to reduce vibration from whipping of the stock. A forced-feed automatic lubricating system in the top brace supplies oil to all spindle bearings and the spindle carrier support bearings. The front bearing on each spindle consists of three high-precision straight roller bearings. Drawback collets are employed. Collets and pushers for the Model R are interchangeable with those for the ⅞-in. Model G.

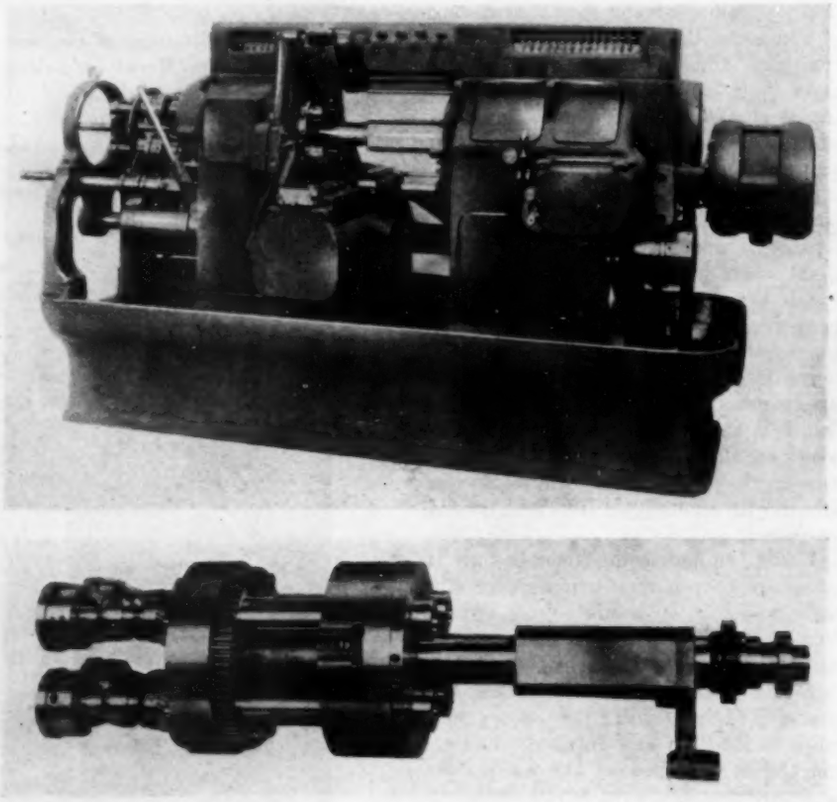
To prevent the feed tubes getting out of mesh with the feed slide when the cylinder is indexed, they are positively controlled by a ring and disk. A large cam prevents opening of the collets in the working positions and serves as a guard to inclose the spindle drive gears.

All surfaces of the main toolslide are ground. Tooling on the main slide is always readily accessible. To afford close control of depth in drilling and reaming and the length of turning operations, a positive stop is provided. Cams for the main toolslide are of alloy steel, and the cam drum is mounted under the gearbox section, easily accessible from either side of the machine. The toolslide guide is mounted on a bracket below the slide, thus leaving the two die slides in the second and third positions open for independently operated threading attachments or accelerated drilling and reaming attachments.

Cross-slides are unusually wide and long, and move on hardened steel ways which are attached to an arch-shaped portion of the main frame. Each of these four cross-slides has a positive stop, easily adjusted to insure accurate depth of the cut in each position. Second and third position slides are mounted at an angle so that every tool and holder is accessible. Chip guards on the inner end of the cross-slides at the first and fourth positions prevent chips from working back underneath the slides. The two bottom cross-slides are operated from cams on separate drums located directly under each slide. A separate cam on each drum moves the upper slide independently through a lever. In the second position, where shaving and skiving tools are commonly used, there are two holes in the lever for the fulcrum pin so that the operator can select a long or short travel for the upper slide without changing the cam. Each of the four slides is independent of the others. A separate drum carrying

SPECIFICATIONS OF THE GRIDLEY MODEL R AUTOMATIC

Standard size of machine	⅞ in.
Maximum capacity of collets:	
Round	⅞ in.
Square	25/32 in.
Hexagon	¾ in.
Maximum length with standard machine:	
Stock feed	5 in.
Turning	5 in.
Range of spindle speeds — r.p.m.:	
Minimum	272
Maximum	2,579
Speed of countershaft	690 r.p.m.
Floor space, including stock stand	15 ft. 4 in. x 2 ft. 7 in.
Net weight, motor drive	6,300 lb.
Standard motor	7½ hp., 1,800 r.p.m.



Better support under heavy forming cuts is secured by increasing bearing width and overall length of the spindle carrier

two sets of cams is located at the front end of the camshaft for independently operating threading, drilling, reaming, or accelerated attachments in the second or third positions.

Productive capacity of the Model R is due in part to the smooth rapid indexing of the spindle carrier, which is accomplished without shock. A modified Geneva mechanism indexes the spindle carrier. The vertical stock stop is in the fourth position and is brought up into place by a mechanism that is entirely inclosed. It drops quickly out of the way after the stock is fed out and the chuck closed, making possible the use of tooling in this position. Thus, the machine has the fourth position available for any standard tooling, and four independent cross-slides make it equivalent to a machine with a greater number of spindles.

Chucking and Feeding

Two large steel shafts support the chucking and feeding slides to prevent binding or wear. The entire mechanism is supported by an arch fastened on the pan of the machine and also affords support to one end of the stock reel. Cams for operating the chucking and feeding mechanism are arranged for quick changes. The guard casting provided to inclose the spindle drive gears also acts as a cam to keep the spools from moving forward, which would release the chuck while tools are engaged on the work.

A safety clutch is built into the worm gear which drives the feed and index mechanism. Feed change gears are mounted on the front of the machine and accessible through a swinging door. Spindle speeds can be varied by change gears at the pulley, or motor, end of the machine. A starting lever is furnished on each side of the machine in convenient location, and a high-speed lever is also furnished on both sides of the machine.

The front disk of the stock reel turns in a reel guide mounted directly on the end of the frame and pan to afford rigidity. Reel pipes are mounted in ball bearings so that they may revolve with the bar stock to eliminate whipping of the stock in the tubes. The design permits removal of chips from the rear of the pan. The reel stand is not in the way.

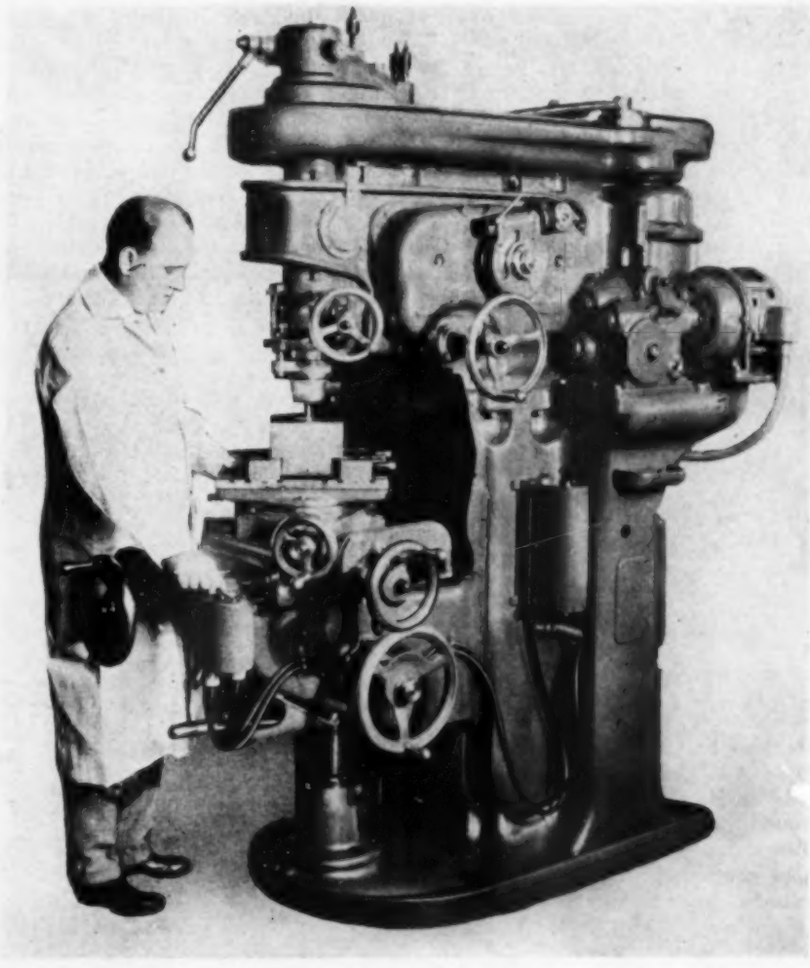
A lubricating pump located in the top section directly over the gearbox forces oil to a series of visible oilers. From these a separate copper tube runs to each bearing. Before throwing in the feed, the operator, by depressing a lever, can send a flood of oil to every bearing, particularly at the beginning of the day's work.

Pratt & Whitney No. 2A Universal Die Sinker

Making cherrying cuts without special attachments or special cutters, and using power to feed the cutter, is the idea behind the design of the No. 2A universal die sinker announced by the Pratt & Whitney Co., Hartford, Conn. These features speed up a difficult hand operation into a quick machine operation and eliminate costly cherrying cutters. Standard die-sinking tools only are used for either straight or cherrying cuts. The machine performs cherrying and straight die sinking operations without changes in set-up. Either the cutter can be moved through a circular path using the oscillating head set at any required diameter, or the entire head can be locked securely in position and the machine used for regular rectangular cutting.

The operating head is equipped with power feed by a separate motor. By means of this head an ordinary die-sinking cutter is moved through a semicircular path to produce a cylindrical cavity. In addition it produces the correct draft on the die, and eliminates cutting the draft by hand afterward.

The entire column, head assembly and knee of the No. 2A machine are of extra heavy design, the entire machine weighing 6,100 lb., including motors and electrical equipment. The table travels in two directions and carries a rotary vise mechanism. Micrometer rings and binders are provided on all slides, and a folding curtain protects the ways from chips and dirt. Handwheels and controls are arranged in duplicate on either side of the machine. Maximum distance from the vise to the end of the spindle is 17½ in. Vertical travel of the knee is 16 in., and travel of the spindle quill 2½ in. Distance from the column face to the center of the spindle is 21 in. Both the longitudinal and



transverse movements of the table are 12 in. each. The vise will take a block up to 9 x 10 in.

The oscillating head contains the spindle quill and spindle at one end, and the spindle driving motor is mounted vertically at the other end. Drive is by means of two sets of V-belts and pulleys with an idler belt tension adjustment. The spindle driving motor is 1 hp., 4-speed, which together with double belt drive provides eight spindle speeds ranging from 300 to 3,600 r.p.m. A vertical lever at the upper end of the spindle housing engages one or the other belt speed and provides a neutral position as well. A second lever at the left of the spindle head actuates a spindle brake.

The oscillating head is mounted on two large eccentrics arranged with an adjustable throw so that the head can be revolved through circles having diameters from 0 to 3½ in. Adjustment for the diameter is on the right side of the head and consists of a worm and wheel actuated by a hand crank. On each side of the head housing is mounted a round dial graduated in various diameters. A pointer attached to the oscillating head moves over the face of this dial to give the position of the cutter at any point during a cylindrical cut. By combining the rotary table feed and the oscillating cutter movements, it is possible to sink a spherical cavity. It also is possible to sink a cherrying cut below the surface of the die. A quarter cylinder can be cut by feeding the cutter to an arc of 90 deg. and using the longitudinal feed. By using the upper half of the oscillating travel, an inverted cylinder or sphere can be produced either on the surface or below the surface of the die. Moreover the oscillating movement "tracks" either forward or backward.

Producto-Matic No. 42 Milling Machine

Intended for short milling cuts in a straight or curved path, the No. 42 Producto-Matic now offered by the Producto Machine Co., Bridgeport, Conn., has a wider scope than previous designs in that it can be changed over quickly for short-run or long-run jobs by the use of simple, inexpensive fixtures. High productive capacity is obtained from the machine by retaining the principles of automatic operation, loading and unloading while milling, and short cutter travel with the work stationary.

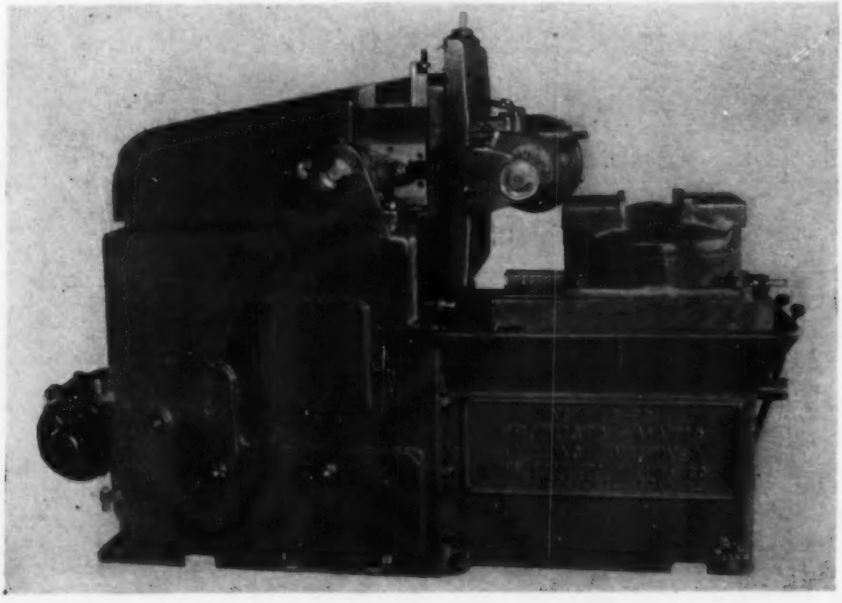
Improvements incorporated in the No. 42 machine are: a drum cam which controls all functions of the machine automatically, and of which the removable cam strips can be changed quickly for different jobs; a two-station type of work fixture table that indexes automatically 180 deg.; vertical as well as horizontal stroke of the cutters to provide an angular or curved cut; large shaper-type ram; worm and worm gear driven cutter spindle; simplified transmission drive; cutter speeds from 30 to 1,400 r.p.m.; work-fixture base machined with T-slots to take inexpensive fixtures and complete control from the operator's position.

The base is made in two sections, the main section housing the transmission, the drum cam and two chambers for the change gears controlling the feeds and speeds. The top of the base is made extra heavy to provide a main slide for the machine. The other section of the base is used for supporting the work table carriage and the fixture. It will be seen that the machine is lower and that greater rigidity is obtained. Motor drive is ordinarily provided for the machine, the average motor size being 7½ hp.

Considering the type of cut taken, the ram and ram bearing are extremely heavy. The ram itself is 41 in. long by 21 in. wide, and the ram does not extend more than 6 in. out of its bearing when the cutter has traveled to the farthest point of milling. Horizontal movement of the ram is secured by means of a hardened steel roll and cam shoe, the latter being adjustable for depth of milling.

Mounted on the forward end of the ram is a large apron type of cutter bearing slide with the cutter spindle bearings cast integral. This slide is 28 in. high by 26 in. wide. Cutter spindle slide has a vertical travel of 12 in., but the actual travel during milling is only 2 in. Cutters up to 13 in. can be used.

The work table consists of an adjustable saddle that receives the work fixture turret. Fixtures up to 20 in. are received as standard. Indexing and locking of the work fixture turret are controlled automatically from the drum cam. In general, the machine is made to index the fixture 180 deg., but it can be made to index at four or six divisions. The machine has been designed for universal use in any milling department and for a wide variety of milling operations.



Norma-Hoffman "CD" Ball Bearing

The Norma-Hoffman Bearings Corp., Stamford, Conn., has announced the Type "CD" duplex double angular contact ball bearing, which is adapted for radial loads and high thrust loads in either direction. The width is no greater than that of a standard single-row ball bearing. The outer ring is made in two parts, and both inner and outer raceways are ground to a special curvature. A one-piece ball retainer of extruded bronze rides, or is carried, upon the ground flanges of the inner ring. These bearings are available in light, medium, and heavy metric series in a range from 10-mm. to 100-mm. bore.

De Vlieg No. 5 General-Purpose Milling Machine

To fit the duty of general-purpose heavy milling the De Vlieg Machine Tool Co., Jackson, Mich., has designed the No. 5 milling machine. Positioning of the head for distance between center of spindle to top of table and locking is automatic. All functions of this machine are operated electrically. Six standard line-start motors, one for each unit, provide driving means. Standard control apparatus on one panel coordinates with mechanical means for operation.

Eight speeds, from 18 to 250 r.p.m., are furnished to the spindle which is mounted on Timken bearings. A range of speeds from 36 to 500 r.p.m. is optional. Positioning of the spindle and head in vertical relationship to the table is automatic. The desired position is selected with a micrometer dial. A lever at the left front portion of the machine effects unlocking, feeding to the selected position and locking automatically. This positioning is said to be dependable to 0.0005 in.

Table feeds range from 0.8 to 32 in. per min. in 16 steps. Rapid traverse is 250 in. per min. Both are operative in either direction. This range is derived from a gearbox driving a hardened and ground feed screw equipped with an automatic backlash remover. Feeds from 1.6 to 64 in. per min. are obtainable. Spindle speeds are quickly changed by levers located at the front and rear of the spindle head. Controls for the table feed and those for starting and stopping are at the center front and the rear of the machine.

Power vertical feed to the spindle head is operated by a screw, and speeds are changed by quick change gears, giving a selection of eight rates of travel, 2 to 20 in. per min. Individual motor drive is provided for spindle head elevation. Feeds up to 4 to 20 in. per min. are optional.

SPECIFICATIONS

Range	
Center spindle to top of table—max. Std.	20 in.
Center spindle to top of table—max. Spec.	26 in.
Center spindle to top of table—min.	3 in.
Quill adjustment	5 in.
Table feed (standard)	60 in.
Table feed available up to	84 in.
Width between spindle head and braces	29 in.
Table	
Working surface—Std.	22x90 in.
Number of T-slots and width	five ⅝ in.
T-slot spacing	3⅛ in.
Nose of spindle to first T-slot	6½ in.
Height from floor to top of table	36¼ in.
Spindle	
Spindle speed, quick change, Std., 18 to 250 r.p.m.	8
Spindle speeds, quick change, Spec., 36 to 500 r.p.m.	8
Spindle nose (National Standard) with a second flange of 7¼ in. dia. for large cutters.	
Diameter of spindle quill	9 in.
Center of spindle to underside of overarm	7 in.
Feeds	
Table feeds, quick change, Std., 0.8 to 32 in. per min.	16
Table feeds, quick change, Spec., 1.6 to 64 in. per min.	16
Table rapid traverse, in. per min., Std.	250
Vertical feeds, Std., 2 to 20 in. per min.	8
Vertical feeds, Spec. 4 to 40 in. per min.	8

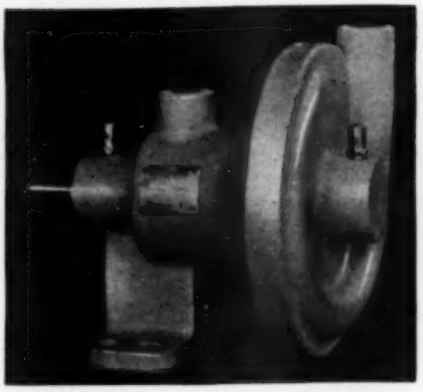
Tomkins-Johnson "Spiral-Flo" Pump

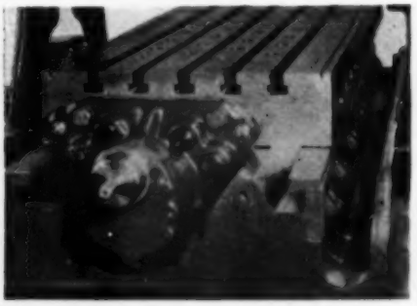
Designed to eliminate necessity for closely fitting and machined parts within the pump chamber, but to provide efficient operation, the "Spiral-Flo" pump has been developed by the Tomkins-Johnson Co., Jackson, Mich. The pump is supplied with ½-in. intake and ¾-in. outlet to provide 7 gal. per min. capacity at 1,000 r.p.m. and 14 gal. per minute at 1,725 r.p.m. With a 1-in. intake and 1-in. outlet it is capable of pumping 31 gal. per min. at 1,725 r.p.m.

The ball bearings in this pump are protected by standard oil seals, and Alemite pressure lubrication fittings are used throughout. Since there is no appreciable back pressure, no relief valve is necessary. The pump will pump either oil or water or any combination of the two and is not affected by grit and chips.

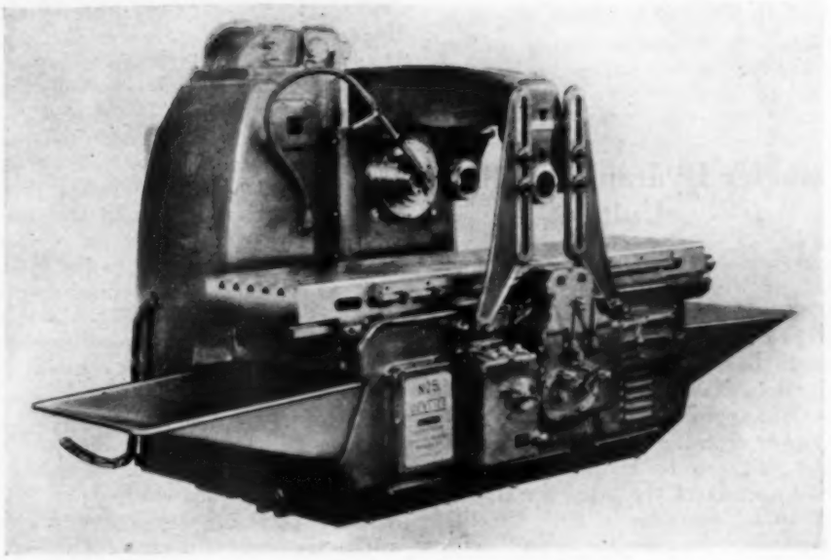
Ingersoll Licenses Allegheny to Manufacture Two-Ply Stainless Steel

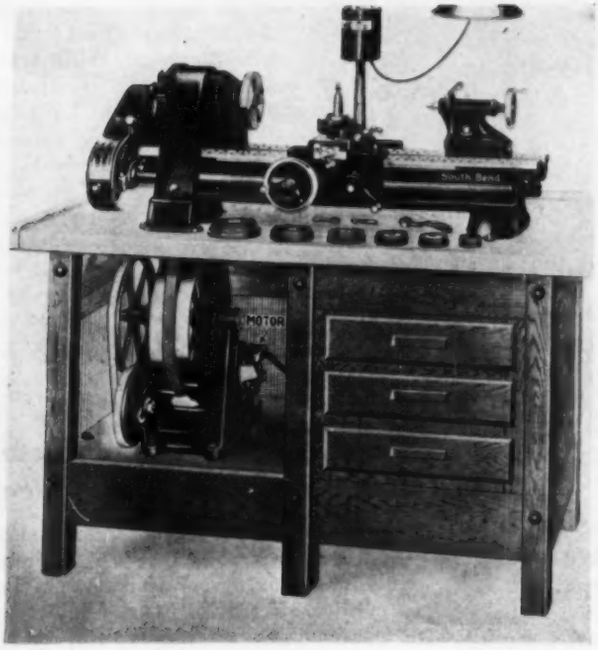
Following the recent announcement of Ingersoll Steel & Disc Co., Chicago, a division of Borg-Warner Corp., that it had perfected an "Ingo-Clad" two-ply stainless steel (*AM*—Vol. 76, p. 917), there is the recent statement that the Allegheny Steel Co., Brackenridge, Pa., has been licensed to manufacture the steel. Both companies have been working for some time to manufacture this two-ply stainless steel.

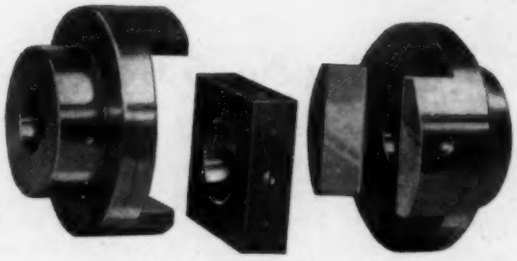


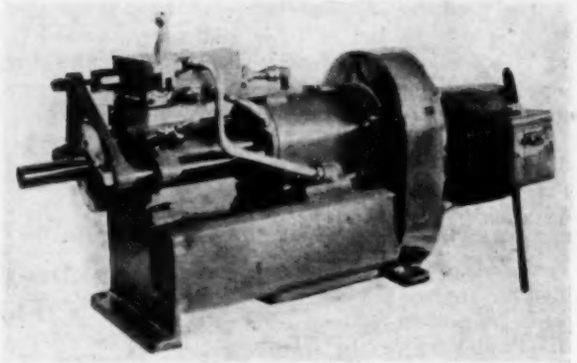


V- and Flat-ways of hardened steel are lubricated automatically. Note the square lock gib









Underneath Drive for Precision Bench Lathe

In the underneath belt motor drive developed by the South Bend Lathe Works, South Bend, Ind., the down-pull feature provides a steady drive which insures accuracy in machining work. Drive is by belt from a reversing motor mounted under the bench, directly beneath the headstock. The lathe is of the back-geared, screw-cutting type and is available in 8, 9 and 11-in. sizes. It will cut all standard screw threads, right and left-hand, from 2 to 90 per in., including 11½ pipe thread. An easy-reading index plate has been added to show at a glance the proper gearing required to obtain any desired tool feed in the wide range provided. Other features of the machine are: six spindle speeds, drum-type reversing switch, graduated tailstock spindle, automatic feeds and precision leadscrew. A belt guard for the cone pulley is optional.

Hoefer Hydraulic Drilling Units

A series of self-contained hydraulically fed drilling units is being offered by the Hoefer Mfg. Co., Inc., Freeport, Ill., to be built into existing equipment or to be attached in any number or size to suitable bases. Standard cycle is rapid approach, feed, rapid return and stop or repeat. For honing operations the unit can be made to reciprocate continuously at the rapid traverse rate of 40 in. per min. in both directions. Feed rates are available in any amount up to the rapid traverse rate, and are variable at will by the turn of a knurled screw knob.

The unit above is the smallest of the series, and is capable of driving a ½-in. drill in steel. It is powered by a 1½-hp. motor running at 1,750 r.p.m., 1 hp. going to the spindle, ½ hp. to the hydraulic feed system when under full load. Other sizes designed and contemplated are up to 10 hp. capacity.

On the unit pictured, spindle speeds from 430 to 3,200 r.p.m. are available by means of splined pick-off gears. When multiple-spindle heads are used, additional ratios are available within the head to give each drill comparable peripheral speeds.

The self-contained hydraulic circuit consists of a herringbone gear pump, an oil reservoir, a relief valve, a compensating feed valve, a reversing piston valve and a cylinder and piston with through, hollow piston rod. Through this non-rotating piston rod the spindle passes and is supported clear of it by ball bearings at each end. In the feed position, the fluid escaping from the back side of the piston is metered through the feed valve and the excess pump discharge escapes through the relief valve. This control valve is compensated by a spring device to the extent that as resistance is met in the work, the back pressure on the back side of the piston is reduced proportionately, thus holding the feed rate constant regardless of work resistance.

Cycle control is by two buttons carried on a slotted bar attached to the control valve. Length of rapid approach and feed is quickly changed by these buttons obtaining any required cycle within the range of the unit. Cycle control by hand is also available. Maximum range of stroke depends upon the length of hydraulic cylinder. For the model shown, standard travel is 5 in., but may be extended to 10 in., if desired.

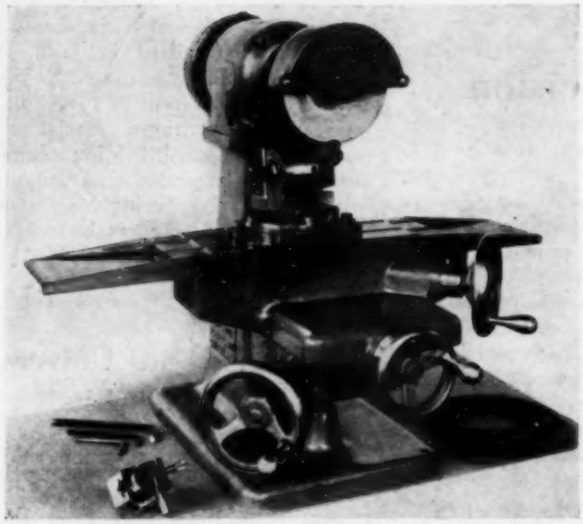
James Flexible Coupling

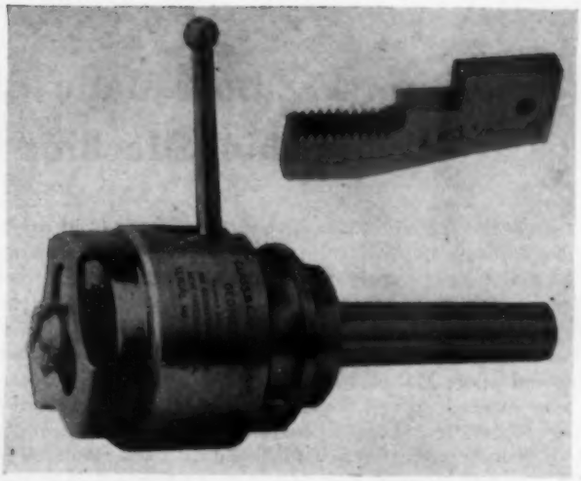
The D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill., is introducing a three-part coupling in which the center member is made of a non-metallic material self-lubricated by means of a reservoir within itself. This center member slides between the jaws of one metal flange on a line passing through the center and is free to slide across the face of the second flange in a direction which is at right angles to the first. The two metal flanges are made of nickel iron.

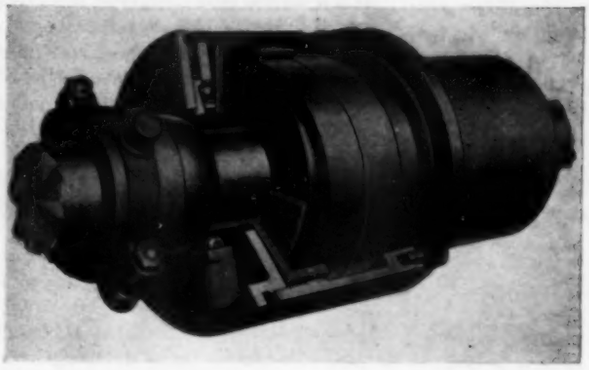
National Acme No. 0 Bench-Type Chaser Grinder

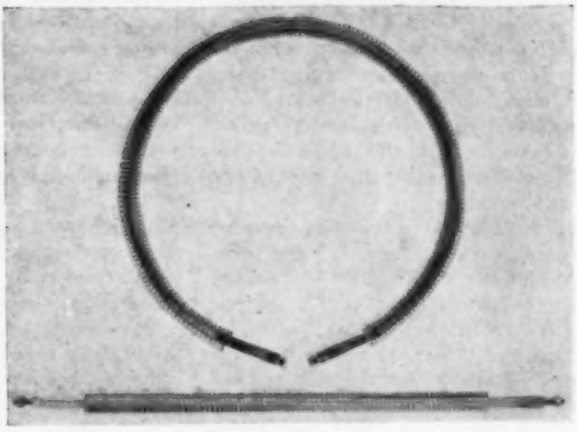
A small, compact chaser grinder, known as the No. 0, has been developed by The National Acme Co., 170 East 131st St., Cleveland, Ohio. The knee can be readily raised or lowered, or the table moved away from the column, so that a wide range of sizes may be handled quickly. This machine can also be furnished with a cast-iron base mounted on casters for portable use.

The table is supported by a V and a flat guide, each provided with an oil pocket and felt wipers. A hold-down gib is furnished to prevent tipping. Table travel is 13 in. Cross-slide movement is









5½ in., and vertical slide movement, 6 in. All slides are protected from grit and dirt by cast-iron aprons.

The motor is a fully inclosed ball-bearing ½-hp. type. The double-ended motor spindle is arranged for a guarded grinding wheel on one end and guarded wire brush for removal of feather edges or burrs at the other end. If desired for general-purpose grinding, a wheel can be mounted on each end of the spindle.

The bench-type grinder with fixture weighs 246 lb. net, and the pedestal, 154 lb. net.

Kinney Disk-Actuated Spiral Friction Clutch

Small diameter and shaft space requirements; high-speed operation; transmission of power in ratio to speed; fully inclosed; single point adjustment; and either dry or lubricated friction surfaces are features of the disk-actuated spiral friction cut-off coupling illustrated. The device is built by the Kinney Mfg. Co., 3541 Washington St., Boston, Mass. The company also builds a disk-actuated spiral friction, sleeve or pulley clutch which is much the same as the cut-off coupling.

Driving mechanism of the cut-off coupling consists of a spiral band contracting on a driving hub, the band being actuated by a flat asbestos-faced friction disk. Power is transmitted by the spiral band. Wear of the spiral does not affect the adjustment. The shifter sleeve is cone type. For the sleeve or pulley clutch, in place of the hub for attaching to the driving shaft the clutch is fitted with a sleeve for mounting the pulley, gear or sprocket. The cut-off coupling and the clutch are built in three sizes to transmit 3, 10 and 18 hp. per 100 r.p.m.

Trent Tubular Electric Heating Element

A variation of the tubular-type heating element has been introduced by the Harold E. Trent Co., 618-640 N. 54th St., Philadelphia, Pa., in the form of a tubular finned electric heating element. In addition to the designs shown, the element can be obtained in the form of spirals of indefinite length.

Geometric Class SL Collapsing Tap

For small hole tapping, the Geometric Tool Co., New Haven, Conn., is introducing a Class SL collapsing tap which is said to have a sturdy, rigidly supported chaser. This tap can be used in live spindles or stationary holders without purchase of additional parts. It may be operated as a plate trip tap, or a spool trip tap and may be reset by the handle or by a fork or yoke riding in the spool section of the closing sleeve. It may be used as a lever trip tap by contacting the handle with a stop.

As shown, the chaser is rigidly supported for its entire length, especially back of the cutting teeth. Construction of the tap makes possible the tapping to a shoulder or to a bottom without the use of special or overhanging chasers. The tap can be used for both right- and left-hand tapping. It is adjustable for size. Over-all length is 4⅞ in.; outside diameter, 3¼ in.; standard shank, 1 in. in diameter and 3 in. long. Capacities are: Diameters — straight threads 1 to 1⅜ in. inclusive; pipe threads, ¾ in.; coarsest pitch, 14: and length, ½ in. or shorter.

Heald No. 47 "Bore-Matic" Precision Finishing Machine

A single-end precision finish boring machine utilizing diamond or tungsten-carbide tools has recently been developed by the Heald Machine Co., Worcester, Mass. This No. 47 "Bore-Matic" is essentially the same as the No. 46 double-end Bore-Matic. However, it has been speeded up and simplified, and is now offered for shops that do not have sufficient work for a double-end machine and for large production shops that prefer to set up two or three single-end machines on individual jobs.

This machine is automatic in operation. It provides a fast boring cycle, easily changed boring speeds and convenience of operation, including loading and unloading. It will finish a wide variety of parts made from any of the free-cutting materials.

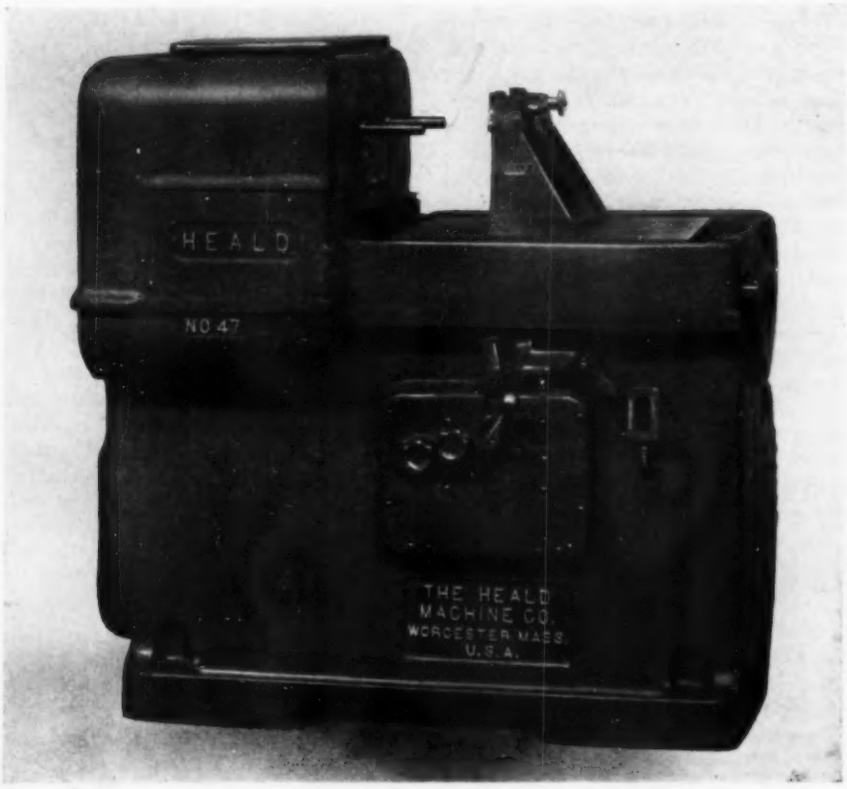
Table ways are completely covered and constantly lubricated. Table drive is hydraulically effected, and feeds range from 1 to 25 in. per min. A finished pad in the center, 16 in. wide by 22¾ in. long, has three longitudinal T-slots. Buttons on the boring-head bridge serve as locating points for lining up the boring heads, and two transverse T-slots provide for clamping them.

Boring head drive is by multiple V-belts from the clutch and brake unit. Spindle speeds can be varied from 1,200 to 5,000 r.p.m. by changing the size of the pulleys. A clutch and brake unit starts and stops the boring heads and is hydraulically operated and self-adjusting. Controls governing every function of the machine are grouped at the front.

The company is in position to furnish diamond or carbide tools and to repair them. Setting of tools is accomplished by a simple unit which not only sets the proper height or size but also the proper rake of the tool. At the top of the gage is a dial indicator reading to ten-thousandths and is used in connection with the tongued spindle below for checking the height of the tool or size of the hole to be obtained. Each size of gage has its corresponding master bar for recording exact tool settings. This assists materially when setting new or resharpened tools.

The boring heads furnished are similar to those used on the No. 46 machine. They are the solid, one-piece body, ball-bearing type. The spindle is ground and balanced. Bearings are preloaded. Driving pulleys for the heads are balanced. Three sizes of boring heads are furnished as standard in both solid spindle and quill types covering a range of bore diameters from ⅞ to 6⅛ in.

General specifications: maximum diameter of hole bored, 6⅛ in.; minimum diameter, ⅞ in.; maximum length of hole bored, 7 in.; boring head speeds, 1,200 to 5,000 r.p.m.; maximum travel of table, 14 in.; power required, 7½ hp.

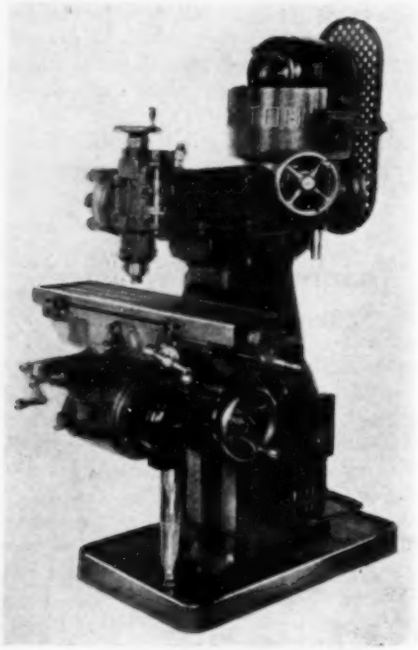


Gorton No. 8-D Universal Milling Machine

A universal milling machine, the No. 8-D, with a high-speed spindle, has been added to the line manufactured by the George Gorton Machine Co., Racine, Wis. The fully universal head is designed for running cutters at high speeds on tool, die, mold and metal pattern work. It is of the same size and has the same cutting capacity as the company's No. 8-D vertical milling machine.

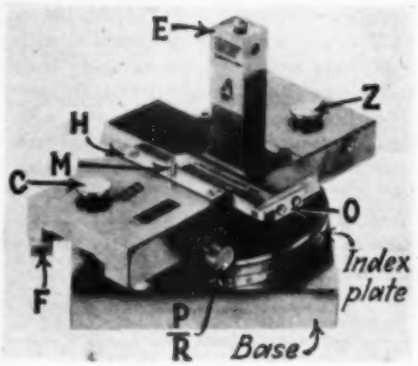
Both heads swivel 360 deg., and these heads are counterbalanced so that they swing at the touch of the hand. They remain at any position without clamping. The sliding head, which carries the spindle and drive complete, is adjusted in and out by a rack and pinion and makes possible a cross feed equal to the longitudinal feed of the table.

Spindle speeds up to 1,800 r.p.m. permit running small cutters and drills for work commonly performed with high-speed attachments. The machine will run a ½-in. high-speed steel end mill to capacity. Power or hand feed to the table is optional. The motor and gearbox for the table feed is assembled



within the knee, and a power feed knee can be furnished or a plain knee substituted without affecting other parts of the machine. Anti-friction bearings are used throughout the machine, and are protected by seals.

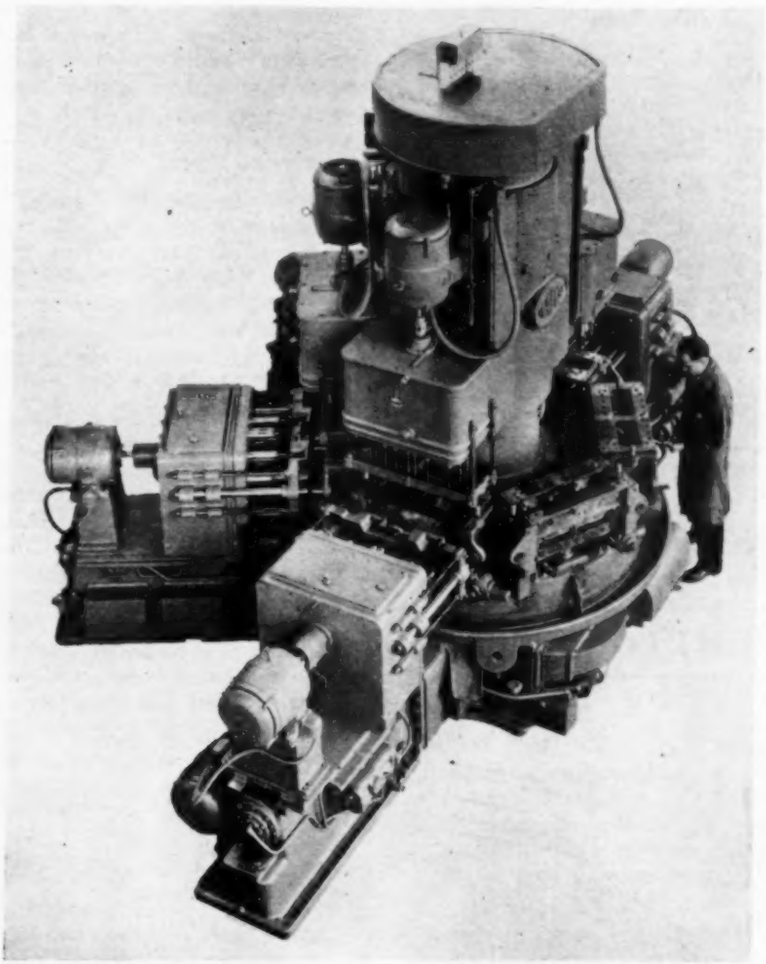
Range is as follows: Table longitudinal feed, 20 in.; table cross feed, 10 in.; sliding head movement, 10 in., which added to the table cross feed makes 20 in.; vertical feed of knee 13¾ in. Weight is 2,100 lb.



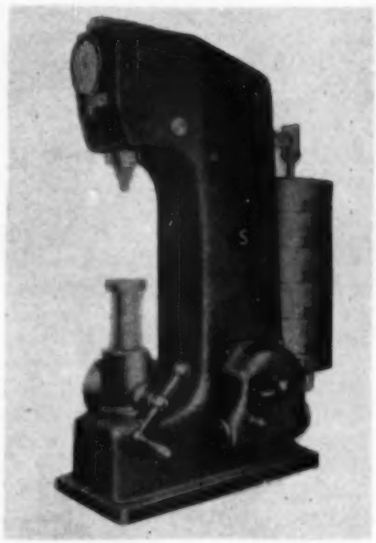
Natco Station-Type, Hydraulic-Feed Multiple-Spindle Drilling Machine

Both vertical and horizontal heads may be arranged on the station-type, hydraulic-feed, multiple-spindle drilling machine announced by The National Automatic Tool Co., Richmond, Ind. This machine may be arranged for either 3, 6 or 8 stations. The machine shown is arranged with six stations, four working and two loading and unloading. It is arranged for four vertical and four horizontal drilling heads.

Indexing of the table from station to station is accomplished by an automatic mechanical indexing mechanism, and the machine is so interlocked that the indexing mechanism will not function unless all heads are in the correct position. The Natco hydro "Uni-Power" system of hydraulic feed is provided, which is semi-automatic in operation. All heads are of the quick-change type, and all spindles are roller bearing mounted and arranged with nose adjustment. A single push button controls the machine.



Natco Station-Type Drilling Machine arranged for performing a total of 132 different drilling and countersinking operations in the bottom and manifold side of a cast-iron cylinder block at the rate of 75 per hr. Weight of machine is 62,000 lb.



Vinco Radius Dresser

Any angle can be dressed tangent to the radius on abrasive wheels by means of the dresser announced by the Vinco Tool Co., 7350 Central Ave., Detroit, Mich. Slide A, which carries the diamond, can be set either by scale, by micrometer or by Johansson blocks. Slide B can be set at desired angle and moved back and forth on the sine bar. Slide B can also be positioned by stop C, so that diamond E is on center of pivot for dressing radius on wheel. Thus the dresser slides and rotates without changing position of the diamond and the angle will be tangent to the radius. Scale H is used to set the diamond to within 0.001 in. Posts M and O are used to measure over with a micrometer or to use measuring blocks between.

"Superior" Brinell Hardness Testing Machine

Brought out by the Steel City Testing Laboratory, 8843 Livernois Ave., Detroit, Mich., is the Model UK-300 motor-driven Brinell hardness testing machine with pushbutton control. The

dead weight system of applying the load permits incorporation of a depth measuring device which, in conjunction with a movable scale, permits hardness tests to be made and read without the use of a Brinell microscope. Screw table for the specimen is elevated and lowered by quick crank adjustment. Loads from 250 to 3,000 kg. can be employed. Maximum vertical opening for specimens is 11½ in., and throat depth is 4¾ in.

• PATENTS •

OCTOBER 4, 1932

Metal-Working Machinery

Crankshaft Lathe. William F. Groene, Cincinnati, Ohio, assigned to R. K. LeBlond Machine Tool Co. Patent 1,880,434.

Boring Machine. John S. Barnes and Ralph B. Billingham, Rockford, Ill., assigned to W. F. & John Barnes Co. Patent 1,880,666.

Worktable for Grinding Machines. John Bath, Worcester, Mass. Patent 1,880,673.

Multiple-Spindle Automatic Lathe. Wilhelm Berg, Bielefeld, Germany. Patent 1,880,681.

Grinding Machine. Clement Booth and Frederick S. Haas, Cincinnati, Ohio, assigned to Heald Machine Co. Patent 1,880,736.

Metal Working Machine. Myron S. Curtis, Pawtucket, R. I., assigned to Potter & Johnston Machine Co. Patent 1,880,843.

Lathe. Arthur N. Emmons, Syracuse, N. Y., assigned to Porter-Cable Machine Co. Patent 1,880,939.

Hydraulic Hold-Down. Robert T. Hazelton, Cincinnati, Ohio, assigned to Cincinnati Shaper Co. Patent 1,881,185.

Multiple Grinder. Clifford T. Raule, Brookline, Pa. Patent 1,881,244.

Tools and Attachments

Apparatus for Shaping the Milestones for Rectifying Gear Teeth. Gustave Ernest Voignier, Paris, France. Patent 1,880,612.

OCTOBER 11, 1932

Metal-Working Machinery

Grinding Machine. Roger N. Heald, Waldo J. Guild, Alfred P. Burns, and George E. Garno, Worcester, Mass., assigned to Heald Machine Co. Patent 1,881,553.

Lathe Having Double End Drive. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,881,762.

Cam Milling Machine. Newman M. Marsilius, Bridgeport, Conn., assigned to Producto Machine Co. Patent 1,881,794.

Grinding Machine. Lester F. Nenninger, Cincinnati, Ohio, assigned to Heald Machine Co. Patent 1,881,870.

Automatic Metal Turning Lathe. William Wallace Potter, Pawtucket, R. I. Patent 1,881,928.

Grinding Apparatus. Alva W. Phelps, Anderson, Ind., assigned to Delco-Remy Corp. Patent 1,881,966.

Slide Mechanism for Precision Grinding Machines. Charles E. Van Norman, Springfield, Mass., assigned to Van Norman Machine Tool Co. Patent 1,881,984.

Machine for Finishing Gears. Edward W. Bullock, Robert S. Condon, and Eyvind Finsen, Rochester, N. Y., assigned to Gleason Works. Patent 1,881,999.

Bracing Means for Shaper Rams. Henry E. Morton, Muskegon Heights, Mich. Patent 1,882,158.

Centerless Grinding Machine. James F. Williams, Lyndhurst, N. J., assigned to General Motors Corp. Patent 1,882,465.

Tools and Attachments

Workhead. Waldo J. Guild, Worcester, Mass., assigned to Heald Machine Co. Patent 1,881,522.

Adjustable Boring Tool. Walter E. Guldager, Detroit, Mich., one-half assigned to Lawrence C. Oak. Patent 1,881,523.

Tool Attachment Device. Ewald A. Arp, Minneapolis, Minn., assigned to Van Norman Machine Tool Co., Springfield, Mass. Patent 1,881,993.

Processes

Method and Apparatus for Relieving Hobs. Ernest C. Head, Rochester, N. Y., assigned to Gleason Works. Patent 1,882,009.

• TRADE PUBLICATIONS •

CHAINS. An illustrated 144-page catalog has just been completed by the Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., on steel chains, being information on older chains brought up to date, together with information on new sizes. The book is known as No. 1192.

CONVEYOR BELTS. Diamond Rubber Co., Inc., Akron, Ohio, discusses conveyor belt problems in "How Shall We Handle It," and gives details of belt construction and suggested applications.

HYPOID AND SPIRAL BEVEL GEARS. Form No. 600, published by the Gleason Works, 1000 University Ave., Rochester, N. Y., is entitled "Engineering Data on Large Hypoid and Spiral Bevel Gears." It gives formulas for calculation of tooth loads and stresses, tables of standard sizes, and much other engineering data.

INDUSTRIAL CLEANING. International Distributors, Inc., 333 N. Michigan Ave., Chicago, Ill., has available a catalog on the "Kerrick Kleaner" for automotive and industrial purposes. The book describes the process, gives laboratory results of cleaning surfaces, shows the various equipments manufactured.

KELLER TOOLROOM MACHINE. Pratt & Whitney Co., Hartford, Conn., has issued a circular on the "Keller" automatic toolroom machine, Type BL, showing many applications of the machine to production of dies and tools besides giving the operating principle and specifications.

METAL DEGREASING. Dow Chemical Co., Midland, Mich., has issued Special Development Bulletin No. 18 entitled "Improved Methods of Industrial Metal Degreasing," which discusses liquid phase and vapor phase degreasing, compares solvents, gives a sketch of degreasing equipment and qualifications of its solvents.

PHOSPHOR BRONZE AND NICKEL SILVER. Riverside Metal Co., Riverside, N. J., has prepared two booklets "Phosphor Bronze" and "Nickel Silver." Both materials are available in sheets, wire, rods, strips and circles. The various alloys in each material are discussed with respect to all forms produced, characteristics and uses.

SHEET METAL WORKING. Catalog No. 94, compiled by the Niagara Machine & Tool Works, 637 Northland Ave., Buffalo, N. Y., contains Bulletin No. 74 on folders and brakes; No. 75 on rotary machines; No. 76 on grooving machines and double seamers; No. 77 on slip roll forming machines; No. 78 on snips and hand tools; No. 79 on lever punches and lever shears; and No. 80 on squaring shears and rotary shears.

SHEET AND STRIP EXTRAS. Inland Steel Co., First National Bank Bldg., Chicago, Ill., has published a booklet on standard extras and differentials, weights, bundling tables, standard tolerances, and trade practices for all Inland sheet products.

WELDING SETS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued leaflet L. 20522-A on the "Flex-Arc" a.c. welder with a current range of 4 to 125 amp., suitable for thin gage material.